Eng FEB 1 1966

LIBRARY
COLLEGE OF ENGINEERING
DUKE UNIVERSITY

# Scientific and Technical Aerospace Reports

A SEMIMONTHLY ABSTRACT JOURNAL WITH INDEXES

DECEMBER 23, 1965

VOLUME 3 • NUMBER 24

N65-35775—N65-36897

DOCUMENTS DEPT.

JAN 21 1966

Duke University Library

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

# Purchase of *STAR*

The semimonthly issues and the cumulative index issues are available postpaid on subscription and in single copy from the Superintendent of Documents, United States Government Printing Office, Washington, D.C., 20402, United States of America.

*Semimonthly issues.* Annual subscription rate: $33.00, domestic; $42.00, foreign. Price per single copy: $2.25, domestic; 25¢ extra for foreign mailing.

*Cumulative index issues.* Annual subscription rate: $30.00, domestic; $35.00, foreign. Price per single copy varies according to the number of pages.

*Domestic subscription rates* apply to the United States, Canada, Mexico, and all Central and South American countries, except as noted below.

*Foreign subscription rates* apply to Argentina, Brazil, British and French Guiana, Surinam, British Honduras, and all other countries throughout the world.

Payment should be by check, money order, or document coupons, and must accompany order. Remittances from foreign countries should be made by international money order, or draft on an American bank, payable to the Superintendent of Documents, or by UNESCO book coupons.

*Published by:*
*United States Government*
*National Aeronautics and Space Administration*
*Scientific and Technical Information Division*

*Scientific and Technical Aerospace Reports*, Volume 3, is prepared by the Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget January 9, 1965

# Introduction

*Scientific and Technical Aerospace Reports (STAR)* is a comprehensive abstracting and indexing journal covering worldwide report literature on the science and technology of space and aeronautics. It is published twice each month.

Major areas covered in *STAR* are:

- Scientific and technical reports of the National Aeronautics and Space Administration and its contractors.
- Scientific and technical reports of government agencies, universities, and research organizations throughout the world.

The first section of *STAR*, arranged by subject categories, contains informative abstracts and complete bibliographic citations. A second section consists of five indexes: subject, corporate source, author, report/accession number, and accession/report number. Separate cumulative indexes are published quarterly, except for the fourth quarter, which is an annual index. Cumulative indexes also contain a contract number index.

Readers are encouraged to examine the abstracts in each category of interest. If time is short, and when interest is concentrated in specific areas, readers may wish instead to scan source, author, and subject indexes. A more thorough coverage of a subject field may often be achieved by detailed examination of the subject listings, especially as they are cross-indexed in the quarterly indexes.

NASA documents (identified with an asterisk), as well as *STAR* itself, are available without charge to:

1. NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.
2. Other U.S. Government agencies and their contractors.
3. Libraries that maintain collections of NASA documents for public reference.
4. Other organizations having a need for NASA documents in work related to the aerospace program.
5. Foreign organizations that exchange publications with NASA, or that maintain collections of NASA documents for public use.

NASA documents identified with the symbol # have been placed on microfiche and are available in that form without charge to the organizations listed above.

Foreign non-copyrighted documents will be provided to U.S. Government Agencies and their contractors. AGARD reports that are not commercially available will also be provided by NASA to the domestic organizations listed above.

Other non-NASA documents are provided by NASA without charge only to NASA Offices, Centers, contractors, subcontractors, grantees, and consultants.

What *STAR* Is

How *STAR* Is Organized

How to Use *STAR*

Availability of *STAR* and Documents

## How to Request Listed Documents

If you are registered with NASA, send a completed *Document Request* (Facility Form 492) to:

Scientific and Technical Information Facility
P.O. Box 5700
Bethesda, Maryland, 20014

If you are eligible to receive documents without charge (see previous page) but are not registered with NASA, request *Registration Form—Technical Publications* (NASA Form 439) from:

Scientific and Technical Information Facility
Attention: NASA Representative
P.O. Box 5700
Bethesda, Maryland, 20014

## How the Public May Obtain Listed Documents

For reference purposes, NASA documents listed in *STAR* may be consulted at one of the organizations listed on the inside back cover. Commercial publications listed in *STAR* may usually be consulted in libraries or purchased from publishers or booksellers.

The public may purchase NASA documents and non-copyrighted foreign documents listed in *STAR* from either of two sales agencies, specifically identified in the abstract section:

- Clearinghouse for Federal Scientific and Technical Information (CFSTI), Port Royal Road, Springfield, Virginia, 22151
- Superintendent of Documents (GPO), U.S. Government Printing Office, Washington, D.C., 20402

Documents available from the Clearinghouse for Federal Scientific and Technical Information are sold in hard-copy and microfiche form. If printed hard-copy is not available, a facsimile copy is provided. The symbols "HC" and "MF" are used in the abstract section to designate the copy available: "HC" for full-size or facsimile; "MF" for microfiche. The price is also given. Following the availability information in the citation of each NASA-supported document is a code, e.g., CSCL 25A, indicating the subject category assigned to that document from the *COSATI Subject Category List* (first ed., December, 1964) published by the Committee on Scientific and Technical Information of the Federal Council for Science and Technology.

The public may request non-NASA documents by writing to the source, or other information systems. Identification other than the NASA accession number (N65-12345) should always be provided when requesting such a document from its source.

## Abstracts of Journal Articles

By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses identical subject categories with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

Organizations having a NASA contract may obtain *IAA* by writing NASA, Code ATSS-A, Washington, D.C., 20546. Others should direct inquiries to the American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, N.Y., 10017.

# Table of Contents

Volume 3 Number 24 / December 23, 1965

*Abstracts in the journal are grouped under the following categories:* PAGE


**01 AERODYNAMICS**

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbomachinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion. . . . . 4085

**02 AIRCRAFT**

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. 4088

**03 AUXILIARY SYSTEMS**

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. . . . . 4090

**04 BIOSCIENCES**

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology. . . . . 4094

**05 BIOTECHNOLOGY**

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences. . . . . 4101

**06 CHEMISTRY**

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants. . . . . 4104

**07 COMMUNICATIONS**

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation. . . . . 4116

**08 COMPUTERS**

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics. . . . . 4121

**09 ELECTRONIC EQUIPMENT**

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation. . . . . 4126

**10 ELECTRONICS**
Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories. **4133**

**11 FACILITIES, RESEARCH AND SUPPORT**
Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations. . . . **4136**

**12 FLUID MECHANICS**
Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion. . . . . **4139**

**13 GEOPHYSICS**
Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences. . . . . **4148**

**14 INSTRUMENTATION AND PHOTOGRAPHY**
Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras. . . . . **4155**

**15 MACHINE ELEMENTS AND PROCESSES**
Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, reliability; drafting; and materials fabrication, handling, and inspection. . . . . **4160**

**16 MASERS**
Includes applications of masers and lasers. For basic research see: 26 Physics, Solid-State. . . . . **4168**

**17 MATERIALS, METALLIC**
Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics. . . . . **4169**

**18 MATERIALS, NONMETALLIC**
Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For ' ic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics. . . . . **4179**

**19 MATHEMATICS**
Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers. . . . . **4182**

**20 METEOROLOGY**
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences. . . . . **4188**

**21 NAVIGATION**
Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications. . . . . **4189**

**22 NUCLEAR ENGINEERING**
Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems. **4190**

**23 PHYSICS, GENERAL**
Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics, 20 Meteorology, and 29 Space Radiation. . . . . 4196

**24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR**
Includes atomic, molecular and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation. . . . . 4200

**25 PHYSICS, PLASMA**
Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems. 4209

**26 PHYSICS, SOLID-STATE**
Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics. . . . . 4214

**27 PROPELLANTS**
Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems. . . . . 4219

**28 PROPULSION SYSTEMS**
Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants. . . . . 4220

**29 SPACE RADIATION**
Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear. . . . . 4224

**30 SPACE SCIENCES**
Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles. . . . . 4229

**31 SPACE VEHICLES**
Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics. . . . . 4236

**32 STRUCTURAL MECHANICS**
Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic. . . . . 4239

**33 THERMODYNAMICS AND COMBUSTION**
Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants. . . . . 4244

**34 GENERAL**
Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents. . . . . 4251

SUBJECT INDEX ..... I-1
CORPORATE SOURCE INDEX ..... I-97
PERSONAL AUTHOR INDEX ..... I-121
REPORT/ACCESSION NUMBER INDEX ..... I-163
ACCESSION/REPORT NUMBER INDEX ..... I-173

VOLUME 3 NUMBER 24

# Scientific and Technical Aerospace Reports

A Semimonthly Publication
of the National Aeronautics and Space Administration

December 23, 1965

## 01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

**N65-35813#** Mississippi State Univ., State College. Aerophysics Dept.
**THE MARVEL PROJECT. PART E: A UNIQUE SOLUTION TO THE PROBLEM OF OBTAINING TWO-DIMENSIONAL BOUNDARY LAYER DATA ON THE VARIABLE-CAMBER HIGH-LIFT WINGS OF THE MARVELETTE AIRCRAFT**
Sean C. Roberts Ft. Eustis, Va., Army Transportation Res. Command, May 1965 33 p refs *Its* Aerophys. Res. Rept. No. 56
(Contract DA-44-177-AMC-892(T))
(USATRECOM-TR-65-16; AD-615928)

This paper reports on the design, construction, instrumentation and preliminary testing performed on the high-lift wing of the MARVELETTE aircraft in a two-dimensional wind tunnel. The wind tunnel, 12 feet high and 2 feet 9 inches wide, was fitted over a section of the aircraft wing to the shrouded propeller at the rear of the vehicle. When operating with this arrangement, wind tunnel velocities up to 60 miles per hour were obtainable in the test section. The tunnel provided more data in a few weeks of operation than would have been obtained in a number of months using a flight program with a considerable number of flights close to minimum flight speeds.
Author

**N65-35827*#** Lockheed-California Co., Burbank, Calif.
**A FLIGHT AND WIND TUNNEL INVESTIGATION OF THE EFFECT OF ANGLE-OF-ATTACK RATE ON MAXIMUM LIFT COEFFICIENT**
Fox Conner, Craig Willey, and William Twomey Washington, NASA, Oct. 1965 55 p refs
(Contract NAS4-471)
(NASA-CR-321) CFSTI: HC $3.00/MF $0.50 CSCL 01A

The effect of angle-of-attack rate on maximum lift at stall was investigated for a related series of six half-wing models in a blowdown wind tunnel as well as for a single-engine, jet-propelled airplane. Mach numbers from 0.25 to 0.75, Reynolds numbers from 1.4 to 21 × $10^6$, thickness ratios of 9, 13 and 18%, sweep angles of 0 and 35 degrees, aspect ratios of 3 and 6 and cambers corresponding to ideal lift coefficients of 0 and 0.2 were tested. All wings were composed of $65_1$-XXX (a = .5) airfoil sections. The increase in the maximum lift with angle-of-attack rate was small and, in general, linear. There were no clear indications of a limit for the maximum lift obtainable. Of the parameters tested, thickness, camber and sweep had the greatest effect. The effect of angle-of-attack rate on maximum lift was increased as camber of thickness decreased, or sweep increased. The flight test results correlated with the trends derived from the wind tunnel tests.
Author

**N65-35829*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EFFECT OF CONFIGURATION VARIABLES ON THE SUBSONIC LONGITUDINAL STABILITY CHARACTERISTICS OF A HIGH-TAIL TRANSPORT CONFIGURATION**
Edward J. Ray and Robert T. Taylor Washington, NASA, Oct. 1965 127 p refs
(NASA-TM-X-1165) CFSTI: HC $4.00/MF $1.00 CSCL 01A

The effects of body size and shape, nacelle size and location, wing leading-edge devices, wing double-slotted flap, wing section, and horizontal-tail vertical position, size, and taper ratio on the longitudinal aerodynamic characteristics of a high-tail transport configuration, were studied by wind tunnel experiments. Tests were conducted at a Mach number of 0.21 and a Reynolds number of 0.78 × $10^6$, based on the wing mean aerodynamic chord. Mach number effects were also determined in a transonic dynamic tunnel at an angle-of-attack range extended from about −5° to 50°. Experimental results on the control effectiveness of horizontal stabilizers, the spoiler, aileron, and rudder controls of the test configurations are also included. An increased horizontal-tail size was found to have a favorable effect on the post-stall pitch curve. Relocation of the aft-mounted nacelles to positions where the nacelles were shielded by the wake of the wing or fuselage improved the post-stall pitching moment considerably.
G.G.

**N65-35831*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**INVESTIGATION OF A TWISTED CAMBERED WING WITH A 75° SWEPT LEADING EDGE AT MACH 3 AND REYNOLDS NUMBERS TO 39 × $10^6$**
John A. Moore Washington, NASA, Oct. 1965 25 p refs
(NASA-TN-D-3031) CFSTI: HC $1.00/MF $0.50 CSCL 01A

Tests were made on a model of a wing designed for a cruise Mach number of 3. The wing had a leading-edge sweep of 75° and was twisted and cambered to produce a maximum lift-drag ratio at a design lift coefficient of 0.1. The tests were

conducted at a Mach number of 3.01 and Reynolds numbers based on the mean aerodynamic chord of $10.9 \times 10^6$, $20.4 \times 10^6$, and $38.9 \times 10^6$. The maximum lift-drag ratio of the wing increased with increasing Reynolds number but was considerably below the values predicted by linear theory. These low values of maximum lift-drag ratio resulted from the fact that the drag-due-to-lift values were larger than the theoretical values and that the minimum drag coefficient, although lower than the theoretical value, occurred at a low value of the lift coefficient. The large values of the drag due to lift seemed to be caused by partial separation of the flow on the upper surface of the wing, which was due to the presence of supercritical flow in this region. Author

**N65-35837*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**A DESCRIBING-FUNCTION ANALYSIS OF THE STABILITY OF A LAUNCH VEHICLE WITH NONLINEAR THRUST VECTORING**
Harold C. Lester Washington, NASA, Oct. 1965 39 p refs
(NASA-TN-D-3064) CFSTI: HC $2.00/MF $0.50 CSCL 01A

The stability characteristics of a representative launch vehicle utilizing a type of nonlinear thrust vectoring are investigated by the describing-function method. The nonlinearities in the system are associated with the control thrust forces which are produced by an auxiliary engine rotating through large gimbal angles with predetermined limits imposed on the amplitude of rotation. Limit amplitudes as large as $\pm 90°$ are considered and a describing function is derived to approximate the nonlinearities introduced by the amplitude limits and the sine coupling of the control engine with the rigid-body launch-vehicle equations of motion. Stability bounds for the system are determined graphically by means of a gain-phase analysis for various combinations of the control system and excitation parameters. Selected stable limit cycles, predicted by the describing function analysis, are verified by using an analog computer simulation of the launch-vehicle configuration. Author

**N65-36200#** General Electric Co., Philadelphia, Pa. Re-Entry Systems Dept.
**FLIGHT DYNAMICS DATA PROCESSING FUNDAMENTAL GUIDELINES Fundamentals Memo 81**
A. M. Mundy 25 Jun. 1965 25 p refs

A resume of fundamental procedural guidelines that have been utilized in the evaluation of bias corrections, filter selection, consistency checks, and various other aspects of flight test analysis for ballistic vehicles is presented. Included are up-range data considerations, rate gyro data characteristics and biases, rate gyro filtering and editing, accelerometer data characteristics, post-reentry data, and angle of attack considerations. G.A.L.

**N65-36310#** Hughes Tool Co., Culver City, Calif. Aircraft Div.
**EFFECTS OF BLADE STALL ON HELICOPTER ROTOR BLADE BENDING AND TORSIONAL LOADS Final Report**
S. V. La Forge 1 May 1965 121 p refs
(Contract NOw-0422-c)
(HTC-AD-64-8(347-V-1002); AD-619713)

The highest blade dynamic loads tend to occur under conditions of retreating blade stall. An investigation was made to compare measured and calculated blade bending loads under such conditions. The analysis is based on the use of normal modes and the numerical solution of the differential equations of motion (which eliminates the limitations caused by using harmonics of airloads). It also permits more accurate allowance for aerodynamic nonlinearities in the stalled region. The analysis also includes negative aerodynamic torsional damping when blade stall occurs, as well as the effects of blade bending and torsional deformations on airloads. Finally, the analysis includes an investigation of the effect of hysteresis of the lift coefficient/angle of attack relationship in stall. The predicted bending moments based on use of static values of lift coefficient are approximately half of the measured values. When hysteresis of the lift coefficient/angle of attack relationship in stall is used, the calculated bending moments are found to be of the same order as those measured in flight. Author

**N65-36335#** Royal Aircraft Establishment, Farnborough (England).
**SIMPLIFIED SPECTRAL ANALYSIS OF THE MOTION OF AN AIRCRAFT WITH A SATURATING YAW-DAMPER**
J. G. Jones May 1965 36 p refs
(RAE-TR-65100) CFSTI: HC $2.00/MF $0.50

The response to the lateral component of turbulence of an aircraft with a saturating yaw-damper is investigated. Booton's concept of the equivalent gain of a non-linear element is used in finding the variation of root mean square amplitude of aircraft response with root mean square gust level. In addition the spectral distortion due to non-linearity is described. Author

**N65-36387#** Weapons Research Establishment (Australia).
**PRESSURE DISTRIBUTIONS ON PLANAR AND CRUCIFORM DELTA WINGS ATTACHED TO CYLINDRICAL BODIES IN SUPERSONIC FLOW. PART I: THEORETICAL RESULTS FOR THE WING THICKNESS CASE**
Y. Y. Chan and L. M. Sheppard Jun. 1965 100 p refs
(WRE-HSA-18) CFSTI: HC $4.00/MF $0.75

The method of calculating linearised pressure fields on supersonic wing/and quasi-cylindrical body combinations is applied to circular cylinders carrying delta wings of single-wedge section. Results are given for the wing thickness case only, and angle of attack effects are not considered in detail. The existing theory is extended to cruciform wings and it is shown that the superposition of appropriate planar wing-body pressure fields enables results to be obtained for cruciform combinations. Four cases, covering subsonic and supersonic leading edges, are treated in detail. The results may be applied to planar and cruciform combinations with delta wings of 50° sweepback at free stream Mach numbers of 1.40, 1.61, 2.00 and 2.58. Author

**N65-36462#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**FREE FLIGHT FORCE MEASUREMENTS IN THE GRUMMAN HYPERSONIC SHOCK TUNNEL**
A. Johnson and H. Hopkins May 1965 22 p refs Presented at 23d Semiann. Meeting of the Supersonic Tunnel Assn., 3-4 May 1965
(RM-2785)

The basic optics of the schlieren system were used to obtain measurements on the drag of a sphere in a hypersonic shock tunnel. Calibration results of a Mach 13 conical nozzle are shown as a plot of Mach number versus axial distance from the nozzle exit. Three component data were also measured for a typical planetary entry model in three separate runs under free stream conditions. One run covered an attack angle of 40°. Data reduction equations are presented, and the methods for data reduction are discussed. G.G.

N65-36602# National Aerospace Lab., Tokyo (Japan).
**A SIMPLE METHOD OF CALCULATING THE OFF-DESIGN PERFORMANCE OF MULTI-STAGE AXIAL-FLOW COMPRESSOR**
Masakatsu Matsuki and Shoichi Fujii 1965 10 p refs In JAPANESE; ENGLISH summary
(NAL-TR-82; UDC-621.63) CFSTI: HC $1.00/MF $0.50

Presented in this report is a simplified approach to the calculation of off-design performance that differs in concept from previous methods. The authors generalized the stage characteristics without using the flow and pressure coefficients so that the effects of aerodynamic compressibility on the generalized stage characteristics could be taken into account. The derived stage-characteristics was stacked stage by stage to get the over-all performance of the multi-stage compressor. The agreement with the experiment was fairly good. Author

N65-36604# National Aerospace Lab., Tokyo (Japan).
**EXPERIMENTAL INVESTIGATION ON TRANSONIC TURBINE CASCADES. II: SCHLIEREN TEST RESULTS**
Hiroshi Kondo, Mitsuhiro Minoda, and Norio Yamazaki 1965 32 p refs In JAPANESE; ENGLISH Summary
(NAL-TR-84; UDC-533.6.011.3/5) CFSTI: HC $2.00/MF $0.50

Schlieren test results on four cascades used in a transonic turbine have shown that the variations in performance at transonic speed can be accounted for by shock wave and boundary layer interaction. In nozzle blade, the fall in loss coefficient as the outlet Mach number rises over unity is shown to be due to the fact that the point of separation of boundary layer moves back towards the trailing edge. In impulse blades, as the outlet Mach number rises the shock system on both surfaces of the blades continues to develop, and the rise in loss coefficient does not cease probably because of the differences between these two kinds of blades regarding the profile of pressure distribution on the rear part after the throat section of cascades. Author

N65-36605# National Aerospace Lab., Tokyo (Japan).
**LINEARIZED AERODYNAMIC THEORY OF ROTOR BLADES. II: LIFTING-LINE THEORY**
Teruo Ichikawa 1965 37 p refs In JAPANESE; ENGLISH summary
(NAL-TR-85; UDC-629.13.014.7) CFSTI: HC $2.00/MF $0.50

Lifting-line integral equations of the rotor blade are derived from the lifting-surface equation that has been obtained in the previous report. Approximations of the same degree as those in Weissinger's lifting-line theory of the fixed wing are used. The lifting-line equations consist of two equations: an equation of circulation and an equation of "circulation moment". The boundary condition is expressed in a form suitable to the lifting-line theory. The section aerodynamic loading can be expressed by the circulation and the circulation moment. Finally, the case of steady vertical flight is considered in which a part of the kernel function can be expressed by the same series of modified Bessel functions as that in the propeller theory. Author

N65-36606# National Aerospace Lab., Tokyo (Japan).
**A METHOD FOR PREDICTING THE OFF-DESIGN PERFORMANCE OF MULTI-STAGE AXIAL-FLOW COMPRESSORS OPERATING IN THE TRANSONIC FLOW**
Masakatsu Matsuki, Shoichi Fujii, and Mitsuo Gomi 1965 20p refs In JAPANESE; ENGLISH summary
(NAL-TR-86; UDC-621.63) CFSTI: HC $1.00/MF $0.50

This study was conducted to determine the possibility and reliability with which *multi-stage* axial-flow compressor performance at off-design conditions may be predicted. The partial differential equation for radial equilibrium could be reduced to the ordinary differential one within our assumptions and moreover blade-element loss coefficients were assumed to be depending on the inlet condition of the blade row only. The test comparisons suggest that this practical method of analyzing the performance may be useful in the process of designing a jet-engine multi-stage compressor. Author

N65-36640# Eidgenössische Technische Hochschule, Zürich (Switzerland).
**STATIC BEHAVIOR OF GAS TURBINES WITH MOVABLE GUIDING VANES [STATIONARES BETRIEBSVERHALTEN VON GASTURBINEN MIT VERSTELLBAREN LEIT-APPARATEN]**
Hans Jaggi (Ph.D. Thesis) Juris-Verlag, 1964 138 p refs In GERMAN
(PROM.-3452) CFSTI: HC $4.00/MF $1.00

Qualitative calculations of gas turbine performance characteristics established their dependency on a stable temperature and pressure environment. Installation of movable guiding vanes gives more flexibility and ensures automatic adjustment to fluctuations in these parameters. Flow profile calculations for blades positioned at various angles are used to calculate the stress behavior of a small gas turbine with a single stage compressor. Transl. by G.G.

N65-36679# France. Office National d'Etudes et de Recherches Aérospatiales, Chatillon-sous-Bagneux.
**CONTRIBUTION TO THE SCHEMATIC STUDY OF SEMI-BALLISTIC TRAJECTORIES AT LONG RANGE [CONTRIBUTION A L'ETUDE SCHEMATIQUE DES TRAJECTORIES SEMI-BALISTIQUES A GRANDE PORTEE]**
Pierre Contensou 1965 25 p refs In FRENCH Presented to the Maritime and Aeron. Tech. Assoc. (A.T.M.A.), Paris, 26–30 Apr. 1965
(ONERA-TP-237) CFSTI: HC $1.00/MF $0.50

The schematization of trajectories composed of successive ballistic arcs interrupted by oblique pull-out is presented. It is based upon a theory of optimal pull-out, for minimization of velocity loss for certain trajectory angles. The results are then applied to the discussion of the optimal constitution of the trajectory itself. Transl. by G.A.L.

N65-36697# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Freiburg (West Germany). Institut für Angewandte Mathematik und Mechanik.
**CONTRIBUTION ON APPROXIMATION THEORY OF COMPRESSIBLE LAMINAR BOUNDARY LAYERS WITH HEAT TRANSFER [BEITRAG ZUR NAHERUNGSTHEORIE KOMPRESSIBLE LAMINAR BOUNDARY LAYERS WITH HEAT MEUBERGANG]**
A. Walz Porz-Wahn, DVL, Aug. 1965 8 p In GERMAN Suppl. to Rept. DVL-281(1963)
(DVL-281a) CFSTI: HC $1.00/MF $0.50

Compared are two approximation methods for compressible laminar boundary layers with heat transfer at Mach numbers $M_\infty = 1.50$ and $M_\infty = 1.76$. One method applies the dynamic pressure of the velocity to make the friction value dimensionless, and the other uses the localized dynamic pressure to find the friction value. A good agreement between both methods was found for the lower Mach number, but at $M_\infty = 1.75$ a 10 percent lower friction value was found through approximation of the localized dynamic pressure. Transl. by G.G.

**N65-36767*#** Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
**MEASUREMENTS OF NONEQUILIBRIUM EFFECTS IN AIR ON WEDGE-FLAT-PLATE AFTERBODY PRESSURES**
R. J. Vidal and F. Stoddard Washington, NASA, Nov. 1965 76 p refs
(Contracts NAS1-2812; AF 49(600)-928)
(NASA-CR-328) CFSTI: HC $3.00/MF $0.75 CSCL 01A

Experimental heat transfer and pressure data are presented for a flat plate with large and small-scale wedge leading edges. These data, obtained in high temperature air, are compared with various theoretical estimates to determine the effects of thermochemical nonequilibrium. Data obtained with the small-scale model under high temperature conditions, in which the entire flowfield should be frozen, are found to correlate well with low temperature data if a nonlinear temperature–viscosity relation is used in the similarity parameters. The data obtained under conditions in which the flowfield is not frozen show large nonequilibrium effects on afterbody pressure; the pressure is 25%–35% less than the equilibrium-gas value. It is found that these effects can be estimated using nonequilibrium normal shock wave results to calculate the flow on the wedge face, and by assuming the flow is frozen in the expansion process at the wedge shoulder. At the low temperatures (3300° K) substantial effects result from vibrational nonequilibrium, while at the higher temperatures (6600° K) the effects result from vibrational and chemical nonequilibrium. Author

**N65-36818#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.
**SHOCK TUNNEL EXPERIMENTS ON FLOWS PAST TRANSVERSE JETS**
Louis G. Kaufman, II Apr. 1965 57 p refs
(RE-209)

This report describes our initial experimental investigation of hypersonic flows interacting with transverse jets issuing from rectangular slots in flat plates. Pressure distributions due to the interacting flows are presented and analyzed for various jet strengths and nozzle geometries for models with and without end plates. Effects of these various parameters are described, and forces due to the interactions are calculated. For all test cases, the major portion (55 to 100%) of the interaction force is due to the overpressures on the surface downstream of the jet orifice; however, when flow separation occurs ahead of the jet, substantial forces are generated in this region. Author

**N65-36837#** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
**UNSTEADY AERODYNAMICS FOR ADVANCED CONFIGURATIONS. PART IV: APPLICATION OF THE SUPERSONIC MACH BOX METHOD TO INTERSECTING PLANAR LIFTING SURFACES**
M. T. Moore and L. V. Andrew Wright-Paterson AFB, Ohio, AF Flight Dyn. Lab., May 1965 144 p refs
(Contract AF 33(657)-10399)
(SID-64-1512-4; FDL-TDR-64-152, Pt. IV; AD-619396)

In this volume, Ashley's approach to mutual interference theory by source superposition methods has been applied to the prediction of supersonic air loads on intersecting thin lifting surfaces in steady or oscillatory motion. Each surface may be oscillating in a mode of rigid or elastic vibration or linear combinations thereof. Evvard's diaphragm concept has been extended to treat the out-of-plane interference problem. The study reported herein has lead to the formulation of a method by which diaphragm regions can be selected that eliminate the need for calculating out-of-plane velocity potentials. The method requires only the calculation of out-of-plane velocities so that tangential flow conditions may be met. The Mach-box method has been used to obtain an approximate solution. Each surface and diaphragm is overlaid with a grid of rectangular Mach boxes, the diagonals of which are parallel to the Mach lines. For purposes of calculating induced velocities and velocity potentials, the source strength over the area of each box is assumed to be constant. Out-of-plane velocity influence coefficients are calculated for the center of each box in the interference region, and the tangential flow condition is satisfied there. For purposes of calculating generalized forces, the resulting velocity potential over the area of each box is also assumed to be constant and equal to the value at the center of the box. Author

**N65-36838#** Lockheed-California Co., Burbank.
**EFFECT OF MACH NUMBER, REYNOLDS NUMBER, AND THICKNESS RATIO ON THE AERODYNAMIC CHARACTERISTICS OF NACA 63A-SERIES AIRFOIL SECTIONS**
O. E. Sipe, Jr. and N. B. Gorenberg Ft. Eustis, Va., Army Aviation Mater. Labs., Jun. 1965 476 p refs
(Contract DA-44-177-AMC-144(T))
(LR-18596; USAAML-TR-65-28; AD-619153)

Force and moment data are presented from wind tunnel tests of two-dimensional symmetrical NACA 63A-Series airfoils of thickness ratios from 9 to 18 percent. The tests were conducted at Mach numbers ranging from M = .30 to M = .94, with Reynolds numbers varying from $R = 2.0 \times 10^6$ to $R = 9.5 \times 10^6$ and at angles of attack as high as 29 degrees. Comparisons are made, wherever possible, with NACA tests of the same or similar airfoils. The transonic similarity rule is used to evaluate the consistency of the date. Author (TAB)

**N65-36840#** Bell Helicopter Co., Fort Worth, Tex.
**WIND TUNNEL TESTS OF A FULL-SCALE ROTOR AT HIGH SPEEDS**
Charles L. Livingston Ft. Eustis, Va., Army Aviation Mater. Labs., Jul. 1965 72 p refs
(Contract DA-177-AMC-42(T))
(BHC-556-099-002; USAAVLABS-TR-65-42; AD-619157)

This report summarizes the results of a wind tunnel program conducted to define the effects of compressibility and advance ratio on the performance of a 46-foot-diameter, three-bladed rotor. Measured rotor profile power increase with lift coefficient and advance ratio were greater than predicted. Airfoil characteristics were synthesized that improve correlation of Mach number and lift effects on profile power. Preliminary radial flow considerations are presented and discussed. Additional analytical and experimental work is recommended to investigate in more detail the effects of advance ratio on profile power. Author (TAB)

## 02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

**N65-36952*#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
**A STUDY OF THE DYNAMICS OF AIRPLANE BRAKING SYSTEMS AS AFFECTED BY TIRE ELASTICITY AND BRAKE RESPONSE**

Sidney A. Batterson Washington, NASA, Oct. 1965 56 p refs (NASA-TN-D-3081) CFSTI: HC $3.00/MF $0.50 CSCL 01B

An analog computer study of an automatic airplane braking system was made in which the effect of tire elasticity and the time required to apply and release brake torque were considered. The equations of motion were derived in general terms for a simplified single-wheel arrangement and then solved on the computer for the particular case of a wheel equipped with a 32 × 8.8 type VII tire. It was found that the braking-system efficiency depended on a complex interaction between the values of tire frequency, brake response time, and skid-control-sensor frequency, and depending on the combinations of these values, the braking-system efficiency could vary from 0 to 90 percent. The solutions also indicated that a braking system which operated satisfactorily in the presence of relatively high or medium coefficients of friction could operate unsatisfactorily at low coefficients of friction. It was also found that for low friction operation, large decreases in both stopping distance and tire skidding could be realized by proper selection of the wheel deceleration value used to generate the brake-release signal. Author

**N65-35965*#** National Aeronautics and Space Administration, Washington, D. C.

**COLLECTED WORKS OF K. E. TSIOLKOVSKIY. VOLUME III: DIRIGIBLES**

A. A. Blagonravov, ed. Oct. 1965 518 p refs Transl. into ENGLISH of the book "K. E. Tsiolkovskiy. Sobraniye Sochineniy. Tom III. Dirizhably" Moscow, Izd. Akad. Nauk SSSR, 1959

(NASA-TT-F-238) CFSTI: HC $3.75/MF $2.50 CSCL 01C

Historical and scientific data are presented on the activities of K. E. Tsiolkovskiy, a Soviet crusader for a reliable, all-metal transport dirigible. Subject areas covered include: (1) theory of the aerostat; (2) variation in aerostat volume; (3) material to be used in producing the aerostat; (4) description of a metal airship; (5) shape of a dirigible; (6) the corrugated metal skin of the aerostat; (7) the principal, longitudinal, cross section of the envelope and its properties; (8) pressure of gas on the cross section of the aerostat; (9) a survey of the principal forces acting on the envelope of the aerostat and their interrelationships; (10) the design of components of a parabolic aerostat; (11) the motion of an airship; (12) the heating of light gas and adjustment of lift; (13) elementaty design of a metal dirigible; (14) a metal dirigible to carry 40 passengers; and (15) compendium of the corrugated steel dirigible. R.R.D.

**N65-36145#** Federal Aviation Agency, Atlantic City, N. J. Experimentation Div.

**POST-CRASH FIRE-FIGHTING STUDIES ON TRANSPORT CATEGORY AIRCRAFT Final Report**

Don W. Conley May 1965 39 p refs

(RD-65-50)

Information was obtained on the effectiveness of helicopter downwash and ground foam equipment in extending the escape time for aircraft occupants in a post-crash fire environment by burning five C-97 aircraft under similar conditions. Additional tests, not involving C-97 aircraft, were conducted relative to rescue path studies. Test data indicated that helicopter downwash extended the escape time when fire existed solely on the upwind side of a C-97 fuselage, but reduced the escape time when fire was on both sides or solely on the downwind side of the fuselage. It was also found that helicopter downwash provided a considerable reduction in the radiant heat and air temperature in a simulated rescue path. For the standard fire condition used and the equipment employed, the ability of ground crews to extend to the escape time was found to be dependent upon the preburn time and the fuselage integrity with respect to emergency doors open or closed. An escape time of 50 seconds was computed for a C-97 with emergency doors open as compared to 138 seconds for a C-97 with emergency doors closed. Test results amplify the need for a quick arrival of extinguishing equipment and a capability for a quick "knockdown" and control of the fire. Author

**N65-36248#** Kaman Aircraft Corp., Bloomfield, Conn.

**UH-2 JET-AUGMENTED HIGH-SPEED RESEARCH HELICOPTER MANEUVERABILITY AND DYNAMIC STABILITY EVALUATION**

W. E. Blackburn and A. A. Whitfield Ft. Eustis, Va., Army Aviation Materiel Labs., Jul. 1965 38 p refs

(Contract DA-44-177-AMC-151(T))

(R-553A; USAAVLABS-TR-65-23; AD-620247)

The results of a flight research program conducted to determine the effect of horizontal thrust augmentation on the maneuverability and dynamic stability characteristics of the UH-2 high-speed jet-augmented research helicopter are presented. The research aircraft, instrumentation, and test program are described. A standard Kaman UH-2 helicopter was modified by the addition of a YJ85 jet engine mounted on the right side of the fuselage for horizontal thrust augmentation. Transient and steady-state load factor maneuvers were examined at various airspeeds and levels of jet augmentation. The maneuver envelope is shown to be expanded by unloading the main rotor through the application of horizontal thrust augmentation. The dynamic stability characteristics of the research vehicle are shown to be basically similar to the standard UH-2. The addition of thrust augmentation tends to increase damping in pitch and yaw and reduce control sensitivity. Author

**N65-36256#** Frankford Arsenal, Philadelphia, Pa. Small Caliber Engineering Directorate.

**DEVELOPMENT OF A WIRE LANYARD TO INCREASE ARMING DISTANCE OF FLARE, AIRCRAFT, PARACHUTE, MK24 Final Report, 26 Jul.–6 Sep. 1965**

A. J. Grandy Aug. 1965 36 p ref

(R-1772; AD-620381)

The Mk 24 aircraft flare is used for illumination of battle areas during tactical night situations and can be launched from the interior or exterior of fixed or rotary wing aircraft. Erratic performance of the fuze arming train in the flare has dictated a need to increase the arming distance especially when the flare is manually launched from helicopters. The object of this program was to develop a small, lightweight wire package that could be easily attached to the flare. The package would provide a 50-foot arming distance prior to actuation of the fuze train. An effective, foolproof system was achieved by programming 50 foot lengths of energy absorption cable on a short length of canvas. This package affords essentially a belted lanyard capable of absorbing the shock loadings imposed by the flare during descent from the aircraft. Programming technique used for the wire when attached to the canvas belting also insures trouble free payout of the wire even under extreme conditions of flare gyration. Drop test results indicated excellent payout characteristics even under violent launching conditions. Author

**N65-36725#** Litton Systems, Inc., St. Paul, Minn. Applied Science Div.

**BALLOON DESIGN DATA IN GORE LENGTH UNITS Scientific Report No. 1**

Justin H. Smalley 1 Jun. 1965 73 p refs *Its* Rept.-2803
(Contract AF 19(628)-5131)
(AFCRL-65-447; AD-619537)

Design data for the shape of natural-shape zero-pressure balloons are given with the total gore length as the non-dimensionalizing length parameter. This is a more convenient form for balloon designers. In addition to the shape coordinates, the cumulative zonal area and volume are given in terms of the total area and volume, respectively. Fully tailored balloons for $\Sigma = 0(0.05)\ 1.0$, cylinder balloons for $0 < \Sigma \leq 0.377$, and cylinder-end balloons for $\Sigma = 0.2$ are presented. The computer programs used are listed. Author (TAB)

**N65-36871#** Melpar, Inc., Falls Church, Va.
**SIMULATION OF HELICOPTER AND V/STOL AIRCRAFT. VOLUME V: SUMMARY OF FINAL RESULTS Final Report, Sep. 1963–Dec. 1964**
Ruth L. Faith Port Washington, N. Y., Naval Training Device Center, Dec. 1964 15 p refs
(Contract N61339-1205)
(NAVTRADEVCEN-1205-5; AD-615452)

This report is a summary of the results, conclusions, and recommendations which were derived from a study program designed to develop the equations of motion of helicopters and V/STOL aircraft in a form suitable for simulation using either an analog or a digital computer. Author

**N65-36885*** National Aeronautics and Space Administration, Washington, D. C.
**THE NEW AIRPLANE (1929)**
*In its* Works on Rocket Technol. Nov. 1965 p 287–307 refs
(See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Design ideas were offered for an airplane capable of carrying 100 or more passengers; with low air resistance due to the absence of framework, struts, wheels, floats, wings, bracing wires, or angle braces; and with minimum weight and maximum strength achieved by uniform distribution of people and loads. Approximate calculations are given for determining flight velocity, friction and inertia resistance, shell weight, horizontal velocity, air density, angle of attack, and maximum energy of the engines. Predictions were also made that these types of airplanes would serve for transition to astro-navigation. M.G.J.

**N65-36886*** National Aeronautics and Space Administration, Washington, D. C.
**THE REACTIVE AIRPLANE (1930)**
*In its* Works on Rocket Technol. Nov. 1965 p 308–320 refs
(See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

The reaction of combustion in ordinary aircraft engines is discussed, and the compression factors of some constant gas or mixture (air) are described. Methods of transforming the conventional aircraft engine into a reaction engine are examined, with a view to increasing velocity in the rarefied layers of the atmosphere. Since the compressible air is cooled by the tail sections of the reactive tube and its temperature is assumed to be constant, equations are derived to determine the work performed to produce compression. Tabulations are given on the relative weight of materials which participate in combustion, and on the required amount of oxygen, air, and nitrogen anhydride for each 100 kgm. The distances covered by the projectile at various altitudes with different forward velocities of flight are also listed. M.G.J.

**N65-36888*** National Aeronautics and Space Administration, Washington, D. C.
**SEMI-REACTIVE STRATOPLANE (1932)**
*In its* Works on Rocket Technol. Nov. 1965 p 340–372 refs
(See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Design concepts and construction details are given for a proposed high speed, high altitude airplane, with the thrust developed by the propeller and the recoil produced by combustion products. Air compressor and propeller designs and functions are discussed, and equations used for determining the parameters are included. Computations are also given for the reactive action of the exhaust gases, and the velocities of the stratoplane in km/sec are shown with the corresponding limiting elongations. M.G.J.

# 03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

**N65-35797*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
**BISTABLE FLUID JET AMPLIFIER WITH LOW SENSITIVITY TO RECEIVER REVERSE FLOW**
William S. Griffin Washington, NASA, 1965 20 p refs Presented at the 3d Fluid Amplification Symp. Sponsored by the U.S. Army Mater. Command, Washington, D. C., 26–28 Oct. 1965
(NASA-TM-X-52120) CFSTI: HC $1.00/MF $0.50 CSCL 13G

A selected bistable fluid jet amplifier is presented which exhibits low receiver-interaction region coupling and which also has reasonable receiver power recoveries and control signal pressures and flows. The receivers are specifically designed to handle load reverse flow such as might be delivered by a piston. If the control signal pressure is increased approximately 50 percent above that necessary to switch the power jet into an unblocked receiver, the jet may be switched into a receiver pressurized at 40 percent of supply. Author

**N65-35825*#** Monsanto Research Corp., Everett, Mass. Boston Lab.
**STUDY OF FUEL CELLS USING STORABLE ROCKET PROPELLANTS Quarterly Report No. 2, 18 May–17 Aug. 1965**
R. F. Drake, L. F. Athearn, R. E. Chute, J. C. Orth, and J. O. Smith [1965] 148 p refs
(Contract NAS3-6476)
(NASA-CR-54742; MRB-5009Q2) CFSTI: HC $4.00/MF $1.00 CSCL 10A

Results in development of rocket fuel cells operating on gaseous $N_2O_4$ and Aerozine-50, and adaptation of these direct reactants for use in producing oxygen- and hydrogen-rich feedstreams for fuel cells, are reported. Catalyst screening programs for Aerozine-50 reforming and $N_2O_4$ decomposition have continued. Four new catalysts were discovered which are active for decomposition of $N_2O_4$; however, none showed much activity below 700° C. Several catalysts active for the electro-oxidation of UDMH were tested, but Rh still appears to be the best overall catalyst. A diffusion barrier will be required to prevent excessive decomposition of fuel on

the electrode. A master routing control carbon electrode with higher than normal carbon matrix density was tested with $N_2O_4$. The diffusion rate through the electrode was not substantially reduced by this method. J.M.D.

**N65-35912#** Eagle-Picher Co., Joplin, Mo. Couples Dept.
**INVESTIGATIONS LEADING TO THE DESIGN AND DEVELOPMENT OF MAGNESIUM/MAGNESIUM PERCHLORATE BATTERIES Third Quarterly Progress Report, Jan. 1–Mar. 31, 1965**
James Sharpe 30 Apr. 1965 33 p
(Contract DA-28-043-AMC-00221(E))
(Rept.-3; AD-618497)

This report describes the significant accomplishments made on the research and development of magnesium/magnesium perchlorate batteries during the past three months. Research on the development of the AN/PRC-62, AN/PRC-25, and PPS-5 have been carried out and considerable advancement has been made. Batteries for each application have been constructed and discharged. The program was directed toward attaining the optimum performance over a temperature range of −40° F to +125° F. Research in relation to additives was continued. Author

**N65-35914#** Naval Ordnance Lab., White Oak, Md.
**TERMINATED EXPLODING WIRE ENERGY SOURCE**
Louis A. Rosenthal Jun. 1965 16 p refs
(NOLTR-65-12; AD-618478)

By placing a discharge or "dump" tube across an exploding bridgewire load, it is possible to by-pass the electrical energy and terminate the explosion of the wire. The dump tube is triggered by a signal derived from the energy removed from the storage capacitor. Author

**N65-36322#** Army Electronics Labs., Fort Monmouth, N. J.
**FUEL CELLS Status Report No. 5**
Stephen J. Bartosh, John M. Mc Donagh, and Walter G. Taschek Jun. 1965 202 p refs
(AD-620114)

This report is a comprehensive survey of work under way in the field of fuel cells in the U.S. and abroad. It covers the work at 86 companies and institutions, indicating persons in charge, principal investigators, supporting personnel, man-year effort, status of work, and description of projects. The information is derived from an annual questionnaire mailed to all groups engaged in fuel cell research and development. The report covers U.S. company funded programs, European programs, and U.S. Government supported programs. Author

**N65-36346#** Nottingham Univ. (England).
**EXPERIMENTS ON SYMMETRICAL WALL REATTACHMENT AMPLIFIERS, PAPER B2**
R. F. Boucher and E. Markland [1965] 16 p refs Presented at 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

The requirements of symmetrical wall reattachment amplifiers, as applied to logic circuits, are reviewed. Since many published results are incomplete either in the description of the device tested or the results obtained, a large scale model was made which provided for measurement of static flow and pressure gains, and of control characteristics, for several geometries and loading conditions over a range of Reynolds number. Sharp-edged and flat-topped receivers were used. In an attempt to obtain adequate gains with satisfactory stability over a range of loadings, various techniques were applied. These included fitting resistances to the control ports, biasing the control flows with bleeds from the supply, and fitting a splitter. It was found that suitably shaping the splitter radically altered the characteristics in a desirable direction; this was by far the most attractive arrangement so far tried, although further investigation is in progress. Author

**N65-36347#** Birmingham Univ. (England).
**SOME EXPERIMENTS ON THE VORTEX VALVE, PAPER C1**
J. Duff, K. Foster, and D. G. Mitchell [1965] 16 p refs Presented at 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

The development of a vortex valve is presented. A model was constructed and flow characteristics under steady state conditions were measured and are presented here. Photographs of vortex build-up are included and discussed. A theoretical model of the vortex has been suggested in which the effects of viscosity can be included, and some of its limitations are explained. A note is also included on the information at present available on the application of the vortex valve. Author

**N65-36348#** Nottingham Univ. (England).
**EXPERIMENTS ON TURBULENCE AMPLIFIERS, PAPER D3**
R. A. Oels, R. F. Boucher, and E. Markland [1965] 8 p refs Presented at 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

The development of a turbulence amplifier is described. When supplied with air at 12 in. water gauge, it produces, in the absence of a control signal, a pressure of 6 in. at the output when blocked. As control flow is introduced, the output pressure falls steeply once the control pressure exceeds 1.2 in., and at 4 in. control pressure, the blocked-load output pressure is well below the control pressure threshold. The control flow is then about one-twelfth of the supply. Each amplifier is capable of controlling 4 similar amplifiers. Author

**N65-36371#** Birmingham Univ. (England). Dept. of Mechanical Engineering.
**AN EXAMINATION OF THE EFFECT OF GEOMETRY ON THE CHARACTERISTICS OF A TURBULENT REATTACHMENT DEVICE, PAPER B1**
K. Foster and N. S. Jones [1965] 20 p refs Presented at 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

In spite of the wide interest which has been shown in fluid jet control devices the detailed mechanisms of fluid flow within these units has not been generally well understood. This paper seeks to explain these mechanisms, within the turbulent reattachment device, by drawing on results obtained from a detailed stucy using a variable geometry model. The influence of parameter changes upon these mechanisms is also explained. Author

**N65-36408#** British Aircraft Corp., London (England).
**THE APPLICATION OF FLUID JET DEVICES TO A MEDICAL RESPIRATOR, PAPER F4**

J. R. Vince and C. C. Brown [1965] 6 p Presented at 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

Fluid amplifiers have been used entirely for a rather complex respirator. Clock pulses at twelve per second are counted down by a series of binary counting stages. The number contained in the counter is compared with a number set in with a control knob. When coincidence is reached a larger switch is made to change over which diverts air either to or from the patient. A flow regulator is situated between this switch and the patient, and controls the amount of air that is pumped into the patient. The medical requirements are discussed. Also mention is made of the pump, filter and some other pieces of ancillary equipment that are required. Author

**N65-36447#** Los Alamos Scientific Lab., N. Mex.
**THE LOS ALAMOS THERMIONIC CONVERSION PROGRAM AND RELATED WORK**
A. W. Blackstock [1964] 10 p refs
(Contract W-7405-ENG-36)
(LA-DC-7073; CONF-650418-1)

Research on thermionic conversion is presented. Discussions are included on the advantages of thermionic conversion, a brief history of thermionic research, a brief description of the operation of a thermionic diode, the division of thermionic research, cesium compatibility testing development and testing of insulators and ceramic-to-metal bonds, in-pile testing and development of fueled emitters, stacked cell design, and theoretical and out-of-pile research related to thermionic research. R.N.A.

**N65-36477#** Martin Co., Baltimore, Md. Nuclear Div.
**SNAP 19 PROGRAM ELECTRICAL INTEGRATION CONCEPTUAL STUDY**
M. Monaco and C. Karr Jun. 1964 23 p refs
(Contract AT(30-1)-3169)
(MND-3069-21)

Several combinations of 30 W and 60 W converters and 30 W generators were analyzed for potential efficiency, reliability, and weight characteristics. A configuration was selected which involved the use of two 30 W generators in combination with two 60 W converters. Two generator–converter systems are paralleled to provide a 60 W package. Appropriate switching and sensing elements provide the capability for an external converter system to signal removal of a failed converter unit from the system. It is shown that for a reliability below 0.97 for the converter for a one year mission time there was no overall advantage in providing redundant characteristics in the power system configuration. E.E.B.

**N65-36478#** Martin Co., Baltimore, Md. Nuclear Div.
**SNAP 19 PROGRAM GENERATOR PROTOTYPE QUALIFICATION ENVIRONMENTAL TEST REPORT, ELECTRICALLY HEATED SYSTEM NO. 2. PART I: HUMIDITY AND DYNAMIC TESTS**
C. L. Riggen Apr. 1965 40 p
(Contract AT(30-1)-3169)
(MND-3169-60)

The results of qualification testing conducted on the thermoelectric generator component of the SNAP-19 radioactive isotope power supply for the Nimbus-B satellite application are described. The generator exhibited acceptable characteristics and performance to meet all prototype qualification requirements under environments of humidity, vibration, and acceleration. Also, the structural integrity of the generator support structure with its major ejection mechanism components was demonstrated. E.E.B.

**N65-36572#** Library of Congress, Washington, D. C. Aerospace Technology Div.
**DIRECT ENERGY CONVERSION IN THE USSR, THERMIONIC CONVERTERS Surveys of Soviet Scientific and Technical Literature**
22 Sep. 1965 154 p refs Comprehensive report
(ATD-P-65-57)

A survey of Soviet scientific and technical literature is presented on the physical foundations of thermionic energy conversion and general operational properties of thermionic converters. Discussions are included on thermoelectron emission, volt-ampere characteristic and difference of contact potential, positive surface ionization and evaporation heats, space charge and its neutralization, transport phenomena, qualitative theory of plasma thermoelements, classification schemes of thermionic energy conversion modes, vacuum with current limited by space charge, vacuum with space charge compensated, rectilinear path mode, Ioffe's concept of a plasma thermocouple, simple diffusion mode, phenomena at increased plasma pressures, discharge mode, and arc mode. R.N.A.

**N65-36588#** Universal Match Corp., Phoenix, Ariz.
**RESEARCH AND DEVELOPMENT DIRECTED TOWARD THE DEVELOPMENT OF GAS GENERATORS Final Report**
F. Schumacher and D. Fyfe 15 Aug. 1965 99 p
(Contract DA-36-039-SC-87362)
(D63-702; AD-620212)

The purpose of this project is to develop improved gas generators to activate zinc-silver oxide batteries employing the Signal Corps metal-tube electrolyte-reservoir activating system. The results of the propellant investigation indicated that one commercial propellant, B. F. Goodrich C-501, and a Unidynamics formulation N-1825B, exhibited the most satisfactory thermal stability and reproducible gas output and pressure-vs-time characteristics after conditioning at 300° F for 168 hours. However, N-1825B propellant was selected for use in the gas generator since it is easily furnished with center perforations and exhibits a low content of hydrochloric acid in its exhaust gases. During gas generator design and development, sealed matches with delays of 0, 0.2, and 0.4 seconds were developed which provided outputs sufficient to ignite the propellant charge. In addition, the original design of the gas generators was modified to incorporate a grain trap nozzle and provide base plug end ignition. A satisfactory test fixture was fabricated for pressure-vs-time and output testing. Author (TAB)

**N65-36590#** Naval Ordnance Test Station, China Lake, Calif.
**DIRECT DIGITAL CONTROL OF VARIABLE-SPEED HYDRAULIC TRANSMISSION**
Gerald E. Kovalenko May 1965 71 p refs
(NOTS-TP-3822; AD-620233)

This report documents a test in which a digital orifice test panel was used with a 7020 hydraulic power drive to study the open-loop response. The 7020 is a typical fleet-used gun and launcher drive unit; the digital orifice panel is an absolute-value and sign-flow control device that accepts binary digital commands and is used to control the output of the variable-displacement pump and fixed-displacement motor of a hydraulic transmission. The test was conducted to establish the capacity and further the study of digital hydraulic controllers. The digital orifice used in the test was a breadboard panel. Author

**N65-36670#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**DIMENSIONLESS CHARACTERISTICS OF GAS TURBINE UNITS WITH SLITTED SHAFTS**
V. A. Rogova and Tu Reng-Yung 2 Jul. 1965 17 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 8, 1963 p 14–17
(FTD-TT-65-671/1+2+4; AD-617678)

The results are presented of designing a gas turbine unit with a slitted shaft at a variable regime and in relative units. Author (TAB)

**N65-36718#** Naval Ordnance Lab., White Oak, Md.
**EXPERIMENTS ON SMALL MHD GENERATORS**
Wallace N. Knutsen Mar. 1965 111 p refs
(NOLTR-64-83; AD-465990)

The capability of an MHD generator using shockheated gases on a re-entry vehicle is shown as a function of vehicle trajectory. Experimental tests of small generators on electric arc sources are described in detail. Results show that boron nitride and/or nylon phenolic can provide suitable generator walls for specific conditions. Tungsten electrodes, properly shaped, would provide the required low voltage electrode drop. The design of a permanent magnet to provide a field for a flight test model is outlined, and the capability of several magnets constructed for the purpose is given. Using the generator and magnet study results, an actual model is proposed and expected test results on a typical re-entry trajectory are given. The output gives a short pulse of power at a high altitude. Author

**N65-36757*#** National Aeronautics and Space Administration, Washington, D. C.
**DEVICE FOR CONVERTING THE IONIZING ENERGY, ENERGING FROM A NUCLEAR REACTOR, INTO ELECTRICITY [SUR UN DISPOSITIF DE CONVERSION, EN ELECTRICITE, DE L'ENERGIE IONISANTE ISSUE D'UN REACTEUR NUCLEAIRE]**
Siegfried Klein and Pierre Kraus Oct. 1965 14 p refs Presented at the Sixth AGARD Combust. and Propulsion Colloq., Cannes, France, 16–20 Mar. 1964
(NASA-TT-F-9598) CFSTI: HC $1.00/MF $0.50 CSCL 10A

For converting the ionizing energy, discharged by a nuclear reactor, into electricity, a device is described in which an electromotive force is created by keeping two hollow metal electrodes, in contact with mercury under vacuum, at different temperatures. Use of gases such as argon, neon, and helium which do not condense under the experimental conditions did not lead to the generation of am emf. A modified device, using a zirconium alloy bar in a $UO_2$-lined steel tube and floating in the heavy water of the reactor, was successful for direct conversion of the ionizing energy of fission products into electricity. Increase in electric power generated was obtained by using completely ionized cesium vapors and a heavier uranium oxide lining. Author

**N65-36781*#** Aeronutronic, Newport Beach, Calif. Applied Research Labs.
**DEVELOPMENT OF A HIGH TEMPERATURE BATTERY Final Report**
W. J. Subcasky, T. M. Place, D. N. Stamires, W. G. Anderson, H. A. Parker-Jones et al 15 Oct. 1965 182 p refs
(Contract NAS3-6002)
(NASA-CR-54731; V-3313) CFSTI: HC $5.00/MF $1.25 CSCL 10A

The results of a program to develop a battery capable of 72 hour operation at an ambient temperature of 800° F are reported. Two types of cells were constructed and discharged. A zeolite separator was used with a lithium–magnesium alloy anode and a molten cuprous chloride cathode in one of these cells. The initial open circuit voltage of this cell was 3.29 V. Also, a specially designed flexible seal of AgCl was used in this cell with a magnesium anode separated from the CuCl cathode by a zeolite membrane. The cell voltage under a load of 6.7 mA/sq cm of zeolite separator area was 1.60 V. In the second type of cell a porous glass separator was used between the lithium–magnesium alloy anode and a solid CuO cathode. This cell showed terminal voltages of the order of 2.1 V under a drain of 6.7 mA/sq cm of separator area with new anodes. The zeolite separator was also tested with a molten Na anode and a molten CuCl cathode. Cell voltage was 2.6 V after removal of the cupric ions present as impurity in the cathode. Various methods for fabrication of the zeolite membranes are discussed. It was found that molten alkali metals destroyed the zeolite or porcelain separators. E.E.B.

**N65-36788#** General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science.
**THERMIONIC REACTOR RELIABILITY**
J. W. Holland 28 Jun. 1965 13 p Presented at the Intern. Conf. on Thermionic Electrical Power Generation, London, 20–24 Sep. 1965
(Contract NObs-90487; ARPA Order 21964PC4980)
(GA-6373; AD-620511)

Thermionic converter network reliability is determined as a function of the network electrical configuration and the converter reliability. The study shows that the most reliable configuration is the matrix type of network, with series-connected converters cross-connected in parallel between converters so that an alternate path for electrical current is provided in the event of an open-circuit failure. It was found that with an optimized cross-connector, the most reliable matrix has about three times as many cells in series as in parallel, which conveniently coincides with the advantage of high voltage production. By supplying a small amount of redundant power to the network at the beginning of operation, matrix reliabilities can be orders of magnitude higher than the reliability of the converters. Author

**N65-36827#** Eagle-Picher Co., Joplin, Mo. Couples Dept.
**LOW TEMPERATURE TESTING OF BATTERY BA-494( )/U Final Report, Jan.–Apr. 1965**
R. E. Barnett [1965] 172 p refs
(Contract DA-28-043-AMC-01222(E))
(AD-617351)

This report presents the data obtained in testing the BA-494( )/U batteries at temperatures from 95° F down to 70° F in 5° F increments. In addition to the temperature study, the rates of discharge were varied from the original specifications as well as modifications in instrumentation. Information of considerable value and interest has been gained through this test program. Some difficulties were encountered which will prove to be advantageous in that recommended corrective actions may be taken or alternates considered. Author (TAB)

# 04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

**N65-35780*#** National Aeronautics and Space Administration, Washington, D. C.
**THE DRINKING STIMULUS AND RATE OF WATER PASSAGE FROM THE STOMACH TO THE INTESTINE [PIT' YEVOYE VOZBUZHDENIYE I SKOROST' PEREKHODA VODY IS ZHELUDKA V KISHECHNIK]**
V. G. Kassil' Jun. 1965 9 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 159, no. 5, 1964 p 1194–1196
(NASA-TT-F-9391) CFSTI: HC $1.00/MF $0.50 CSCL 06P

Evidence is presented in support of a gastric emptying mechanism whereby regulation of the fluid flow from the stomach into the duodenal is realized by virtue of centralized nervous activities, tentative forms of which might be internal temperature, hormonal activity, or variations in the stimulus level of the drinking center. A further indication is that the stomach acts as a reservoir, metering fluids into the organism's interior medium depending on current need. The dependence of gastric emptying on thirst is determined, using "imaginary drinking" experiments and isolating the resultant effects from stimulation of the mucilagenous portion of the duodenum.

**N65-35782*#** National Aeronautics and Space Administration, Washington, D. C.
**A DEVICE FOR RECORDING PRESSURE, PULSE VOLUME, AND MECHANOGRAM ON THE MPO-2 OSCILLOGRAPH [PRISTAVKA DLYA ZAPISI DAVLENIYA, OB'YEMNOGO PUL'SA I MEKHANOGRAMM NA OSTSILLOGRAFE MPO-2]**
N. N. Vasilevskiy and O. Ye. Guzeyev Sep. 1965 8 p ref Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 49, no. 7, 1963 p 886–888
(NASA-TT-F-9581) CFSTI: HC $1.00/MF $0.50 CSCL 06L

The authors describe the construction of a pneumovibrator to be used in recording pulse volume and blood pressure, in plethysmography, and in mechanograms. It is recommended for extensive use under experimental and clinical conditions. Author

**N65-35783*#** National Aeronautics and Space Administration, Washington, D. C.
**THE PROBLEM OF COLLECTING DIAGNOSTIC INFORMATION UNDER SPACE-FLIGHT CONDITIONS AS ONE OF THE TRENDS IN MEDICAL CYBERNETICS [PROBLEMA SBORA DIAGNOSTICHESKOV INFORMATSII V USLOVIYAKH KOSMICHESKOGO POLETA KAK ODNO IZ NAPRAVLENIY MEDITSIVSKOY KIBERNETIKI]**
V. V. Parin and R. M. Bayevskiy Oct. 1965 21 p refs Transl. into ENGLISH of a paper presented at the 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965
(NASA-TT-F-9588) CFSTI: HC $1.00/MF $0.50 CSCL 06B

The function of the medical data collecting systems on board spacecrafts is reviewed. Future long duration flights will require the use of on-board computers and powerful diagnostic algorithms. Author

**N65-35785*#** National Aeronautics and Space Administration, Washington, D. C.
**RESULTS OF CERTAIN ELECTRO-PHYSIOLOGICAL INVESTIGATIONS ON THE "VOSKHOD" SPACECRAFT [REZUL'TATY NEKOTORYKH ELEKTROFIZIOLOGICHESKIKH ISSLEDOVANIY NA KORABLE 'VOSKHOD']**
I. T. Akulinichev, V. V. Bogdanov, D. G. Maksimov, and I. I. Popov Oct. 1965 13 p refs Transl. into ENGLISH of a paper presented at the 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965
(NASA-TT-F-9591) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The crew of the Voskhod spacecraft included a doctor who performed operative medical control and studied the condition of the crew members. The apparatus used for this purpose is described. Author

**N65-35786*#** National Aeronautics and Space Administration, Washington, D. C.
**CERTAIN RESULTS OF PHYSIOLOGICAL AND ECOLOGICAL INVESTIGATIONS OF THE CHLORELLA CULTURE AS A LINK IN A CLOSED ECOLOGICAL SYSTEM [NEKOTORYYE ITOGI FIZIOLOGO-EKOLOGICHESKOGO ISSLEDOVANIYA KUL'TURY KHLORELLY KAK ZVENA ZAKRYTOY EKOLOGICHESKOY SISTEMY]**
Ye. Ya. Shepelev Oct. 1965 15 p refs Transl. into ENGLISH of a paper presented at the 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965
(NASA-TT-F-9592) CFSTI: HC $1.00/MF $0.50 CSCL 06K

Unicellular algae including chlorella, represent one of the leading components of biological life-support systems on spacecrafts. The material balance of that portion of the photosynthesis link based on utilizing unicellular algae is discussed. Author

**N65-35828*#** National Aeronautics and Space Administration, Washington, D. C.
**AN ORIGINAL PROBLEM IN AEROSPACE BIOLOGY: THE EFFECT OF MECHANICAL VIBRATIONS AT THE CELLULAR LEVEL [UN PROBLEME ORIGINAL EN BIOLOGIE AEROSPATIALE: L'ACTION DES VIBRATIONS MECANIQUES AU NIVEAU CELLULAIRE]**
P. Grognot, R. Loubière, and A. Pfister Oct. 1965 7 p Transl. into ENGLISH of a paper presented at the 2d Intern. Symp. on Basic Environ. Probl. of Man in Space, Paris, 14–18 Jun. 1965
(NASA-TT-F-350) CFSTI: HC $1.00/MF $0.50 CSCL 06S

In mice vibrated for 7, 15, or 30 minutes, the authors find an anaphase change of about 40%. The sensitivity of mitosis to mechanical vibrations is confirmed. Author

**N65-35890#** Joint Publications Research Service, Washington, D. C.
**STUDIES ON THE EFFECTS OF ANTI-RADIATION DRUGS**
9 Sep. 1965 15 p refs Transl. into ENGLISH of 2 articles from Farmakol. i Toksikol., (Moscow), v. 28, no. 3, May–Jun. 1965 p 347–349, 351–355
(JPRS-31933; TT-65-32427) CFSTI: $1.00

CONTENTS:

1. PERFORMANCE CAPACITY OF ANIMALS FOLLOWING THEIR IRRADIATION, ADRENALECTOMY AND THE ADMINISTRATION OF ANTIRADIATION DRUGS A. M. Stashkov p 1–5 refs (See N65-35891 24-04)

2. EFFECT OF ANTI-RADIATION DRUGS ON THE MUSCULAR ACTIVITY OF THE SMALL INTESTINE L. F. Semenov, R. B. Strelkov, and V. I. Reshetnyak-Moiseyeva p 6–12 refs (See N65-35892 24-04)

**N65-35891** Joint Publications Research Service, Washington, D. C.
**PERFORMANCE CAPACITY OF ANIMALS FOLLOWING THEIR IRRADIATION, ADRENALECTOMY AND THE ADMINISTRATION OF ANTIRADIATION DRUGS**
A. M. Stashkov *In its* Studies on the Effects of Anti-Radiation Drugs 9 Sep. 1965 p 1-5 refs (See N65-35890 24-04) CFSTI: $1.00

Physical endurance in white mice and in rats following adrenalectomy, administration of antiradiation drugs, and irradiation, was studied. Their performance capacity was directly contingent on the level of oxidizing processes. Adrenalectomized mice and rats showed a 20 to 25 percent greater depression of the physical endurance rate under the action of X-radiation as well as longer duration of barbamyl-induced narcotic sleep, than intact animals. The initial phase of the cystamine-induced depression of physical endurance was approximately 50 percent greater in adrenalectomized rats than in intact animals. G.G.

**N65-35892** Joint Publications Research Service, Washington, D. C.
**EFFECT OF ANTI-RADIATION DRUGS ON THE MUSCULAR ACTIVITY OF THE SMALL INTESTINE**
L. F. Semenov, R. B. Strelkov, and V. I. Reshetnyak-Moiseyeva *In its* Studies on the Effects of Anti-Radiation Drugs 9 Sep. 1965 p 6-12 refs (See N65-35890 24-04) CFSTI: $1.00

The following anti-radiation drugs were studied for their effects on the muscular activities of isolated segments of the small intestines from guinea pigs: Cystamine, $\beta$-mercaptoethylamine, S-(2-aminoethyl) isothiuronium bromide hydrobromide, thiourea, unithiole, maxamine (5-methoxytriptamine), and serotonin. Contractions of the isolated intestinal segment were recorded and compared with control experiments using histamine and acetylcholine. It was found that all sulfur-containing preparations in radioprotective doses caused contractions of the isolated intestinal segment. Serotonin and mexamine caused specific contractions of the isolated intestinal segment that were attenuated by dimedrol, aminazine, to a lesser degree by atropine, and hardly at all by redergam. G.G.

**N65-35916#** Library of Congress, Washington, D. C. Aerospace Technology Div.
**SOME EXPERIMENTAL OBSERVATIONS OF THE EFFECT OF A HIGH-FREQUENCY ELECTROMAGNETIC FIELD *IN VIVO* AND *IN VITRO* [NEKTERA EXPERIMENTALNI POZOROVANI UCINKU VYSOLOFREKVENCNIHO ELEKTROMAGNETICKEHO POLE *IN VIVO* A *IN VITRO*] Translations of Soviet-Bloc Scientific and Technical Literature**
K. Marha 26 Jul. 1965 12 p Transl. into ENGLISH from Pracovni Lekar. (Prague), v. XV, no. 6, 1963 p 238-242 (ATD-T-65-56; AD-618466)

Experimental results obtained through application of centimeter waves to rabbits, young male rats, as well as to *in vivo* experiments on water, saturated solutions of $CO_2$, and on human serum albumin, are presented. It was found that the biological effects of centimeter waves in acute applications are to a certain extent reversible. The breakdown of the organisms occurred only at a certain dose. Repeated irradiations, and also pulsed operation of the wave signal, increased the biological effectiveness; the degree of effectiveness depended primarily on the instantaneous amplitude and secondarily on the mean field flux density. It was concluded that the harmful effects of a high-frequency field on the organism constitute overheating as well as a nonthermal effect, particularly at low densities. G.G.

**N65-35942#** Virginia Univ., Charlottesville. Biochemical Lab.
**ERYTHROCYTE BIOCHEMISTRY**
Alfred Chanutin [1965] 162 p refs
(Grant DA-MD-49-193-64-G133)
(AD-617518)

Among the data presented concerning the biochemistry of erythrocytes are: erythrocyte enzymes, in vivo aging, infant erythrocytes, glutathione, erythrocyte lipids, nucleotide metabolism, phosphate exchange, sodium and potassium transport, sugar transport, amino acid transport, erythrocyte preservation, glucose metabolism, hemolysis, and erythrocyte components. R.W.H.

**N65-36104*** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**EXPERIMENT M-3, INFLIGHT EXERCISER ON GEMINI IV**
Lawrence F. Dietlein *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 41-48 (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

Results of an experiment, which was designed to evaluate on a daily basis the general physical condition of the Gemini-4 flight crew with increasing time under space-flight conditions, are reported. The response of the cardiovascular system (pulse rate) to a calibrated workload was used as a basis for this evaluation. Utilizing mild exercise as a provocative stimulus, no significant decrement in the physical condition of either of the two astronauts was detected during the Gemini-4 mission. It was also found that: (1) the response of the cardiovascular system to a calibrated workload is relatively constant for a given individual during space flight, at least for missions lasting up to 4-days; and (2) the crew was able to perform mild to moderate amounts of work under the conditions of space flight and this ability continues essentially unchanged for missions of up to 4-days. S.C.W.

**N65-36105*** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**EXPERIMENT M-4, INFLIGHT PHONOCARDIOGRAM**
Lawrence F. Dietlein *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 49-59 refs (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

Simultaneous electrocardiographic and phonocardiographic data were obtained from both Gemini-4 crew members. Analysis of these data revealed: no prolongation of the time interval between the onset of electrical systole (Q wave) and the onset of mechanical systole (first heart sound); no prolongation of systole (interval between Q wave and second heart sound); and a marked diurnal rhythmicity in the pulse rate of the command pilot based on the 24-hr Cape Kennedy time cycle. Author

**N65-36106*** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**EXPERIMENT M-6, BONE DEMINERALIZATION ON GEMINI IV**
Paul A. La Chance, Pauline B. Mack, George P. Vose (Tex. Women's Univ.), and Fred B. Vogt (Tex. Inst. for Rehabil. and Res.) *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 61-80 refs Prepared in Part at Tex. Women's Univ. and Tex. Inst. for Rehabil. and Res. (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

A bone demineralization study based on radiographic bone densitometry was conducted on the crew of the Gemini-4 mission. Radiographs were made of the lateral view of the foot and of the posterior–anterior view of the hand. Losses in X-ray absorbance (in terms of X-ray equivalent aluminum alloy mass) in different sites in the os calcis, ranging from 6.20 to 13.42%, were found, with losses in finger phalanx 5–2 falling within a comparable range. X-rays made of the crew at two periods postflight showed progressive increases in X-ray absorbance in these anatomical sites, which reached or approached preflight levels. Losses in X-ray absorbance as exhibited radiographically, were compared to losses in healthy young men in the Texas Women's University bed rest studies. In all cases the losses in the crew exceeded those in the bed rest subjects, indicating that restriction of body movement did not represent the sole factor involved. Other possible responsible factors are discussed, with the conclusion that further studies are needed on a larger number of subjects to isolate some of the variables, including weightlessness, which probably are operative. An important finding was that the X-ray absorption losses in bone, were recoverable within comparatively short periods of time. S.C.W.

**N65-36114*** Oak Ridge National Lab., Tenn.
**EXPERIMENT S-4, ZERO g AND RADIATION ON BLOOD DURING GEMINI III**
Michael A. Bender, P. Carolyn Gooch, and Sohei Kondo *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 217–236 refs (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

Studies on the synergistic effect of zero-g and radiation on white blood cells, which were performed during the Gemini-3 manned space flight; are reported. Experiments consisted of the simultaneous irradiation of a series of samples of whole, human blood with $^{32}P\beta$-rays during the orbital phase of the mission. Flight-crew chromosome aberration analyses were made, and the yields of both single- and multiple-break aberrations were calculated both for the flight and for the ground control portions of the experiment. Results showed that while there was no significant difference between the yields of multiple-break aberrations, the frequency of single break aberrations was significantly higher in the flight samples. It is assumed on the basis of these data, that a synergism between radiation and some space flight parameter exists for human-chromosome aberration production. Since only single break aberrations (deletions) show this effect, it appeared that the effect is on the chromosome-rejoining system, rather than on the breakage itself. Although the experiment failed to confirm the existence of a large synergistic effect, the small positive effect demonstrated was found to be of definite scientific interest. S.C.W.

**N65-36117** Joint Publications Research Service, Washington, D. C.
**REGENERATION OF THE SKELETAL MUSCLES**
Chu Jun *In its* Transl. on Communist China's Sci. and Techol., No. 213 2 Sep. 1965 p 24–37 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peking), no. 7, 20 Jul. 1965 p 618–625 (See N65-36115 24-34) CFSTI: $2.00

The literature on the research of muscle tissue regeneration is reviewed, and evidence is considered which indicates regenerative recovery of damaged tissue may occur to a limited extent. The origin of the regenerating cells, the bud formation theory, the tissue induction theory, and in-vitro culture research are discussed. E.E.B.

**N65-36174#** Wisconsin Univ., Madison. Medical School.
**OBSERVATIONS ON ENERGY METABOLISM IN IRREVERSIBLE HEMORRHAGIC SHOCK Final Technical Report, Sep. 1, 1955–Aug. 31, 1965**
Charles W. Crumpton and Helen Hift [1965] 17 p refs
(Contract DA-49-007-MD-668)
(AD-467957)

Irreversible hemorrhagic shock was studied in dogs and rats. In brief, we believe to have accumulated good evidence for the exclusion of both the liver and the heart from implication in the phenomenon of irreversibility in shock. Heart failure may be a factor in the death of the animal. The liver appears to operate in a cul-de-sac situation in the body of the experimental animal, but is not permanently injured on account of it. Spleen, brain and heart are depleted of norepinephrine and may, therefore, be presumed to be involved in the stress-situation which is set up by the prolonged oligemic hypotension. Liver and lung were found to retain their normal levels of catecholamines: apparently they suffer no great hardship during the oligemic period. The central volume, the closest approximation possible to the amount of blood which is actually received for ejection by the left ventricle, was found to remain remarkably constant throughout the experimental period indicating that the reinfusion requirements arose whenever blood was lost from the central circulation. It is suggested that this blood is sequestered in capillary beds which had heretofore been constricted. Finally a hypothesis is advanced which implicates insulin in the development of the severe hypoglycemia and acidosis which characterize late shock. Author

**N65-36205#** Joint Publications Research Service, Washington, D. C.
**INSTRUCTIONS FOR THE DETERMINATION AND TREATMENT OF POISONING FROM ORGANIC PHOSPHORIC ACID ESTERS**
W. D. Wiezorek, E. Herzmann, H. Matzkowski, and V. Goerisch 11 Oct. 1965 16 p Transl. into ENGLISH from Deut. Gesundheitsw. (Berlin), v. 20, no. 32, 12 Aug. 1965 p 1479–1485 (JPRS-32340; TT-65-32830)

Observations on the occurrence and progress of poisoning from commercial preparations which contain a phosphoric acid ester base are presented. Tables describing the toxicological significance of various commercial insecticides available in East Germany are included, along with recommendations for preventative measures and proposed therapeutic procedures. G.A.L.

**N65-36223#** Los Alamos Scientific Lab., N. Mex.
**POSSIBLE TECHNIQUES TO AID IN ULTRASTRUCTURE ANALYSIS**
J. H. Manley 28 Sep. 1965 26 p refs
(Contract W-7405-ENG-36)
(LA-3389-MS)

Preliminary results are given for a method of introduction of cesium atoms into biological specimens to obtain contrast for electron microscopy. The effect of electron heating of collagen fibrils is illustrated and discussed for the same purpose. Other methods for ultrastructure analysis are proposed. Author

**N65-36249#** Naval School of Aviation Medicine, Pensacola, Fla.
**A DATA PROCESSING SYSTEM FOR THE BALLISTOCARDIOGRAM**

Robert L. Morse Feb. 1965 55 p refs
(NSAM-915; AD-620252)

Operation of a mathematical model of the ballistocardiogram by digital computer and other data processing facilities provides an estimate of arterial elasticity, pulse wave velocity, intra-arterial pulse wave form, and correct ordinates of the acceleration, velocity, and displacement ballistocardiogram. Author

**N65-36376#** European Atomic Energy Community, Brussels (Belgium).

**PHOTOSYNTHESIS AND VIRUS MULTIPLICATION IN *BRASSICA CHINENSIS* L [PHOTOSYNTHESE ET MULTIPLICATION VIRALE CHEZ *BRASSICA CHINENSIS* L]**

A. Goffeau May 1964 242 p refs In FRENCH; ENGLISH summary
(EUR-1648.f) CFSTI: HC $6.00/MF $1.50

The photosynthetic reactions of healthy leaves of *Brassica Chinensis L* were compared, *in vivo* and *in vitro*, with those of leaves infected with the Turnip Yellow Mosaic virus. Chloroplasts isolated from the virus-infected leaves show a higher ATP formation rate than do the chloroplasts from healthy leaves. Furthermore, $CO_2$ assimilation—the chief way of utilizing photosynthetic ATP—is not stimulated neither *in vivo* or *in vitro* in the infected leaves. Hence it is not glucide synthesis that requires faster ATP formation in virus-infected plants. It appears that viral ribonucleic acid induces stimulation of photosynthetic ATP formation in the host cell, thus procuring part of the energy needed for its multiplication. Author

**N65-36377#** Brussels Univ. (Belgium).

**STUDIES ON THE PREPARATION OF LABELLED PROTEINS AND PEPTIDES [RECHERCHES SUR LA PREPARATION DE PROTEINES ET DE PEPTIDES MARQUES]**

J. Léonis Brussels, EURATOM, Jun. 1965 21 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-006-61-10 RISB)
(EUR-1845-f) CFSTI: HC $1.00/MF $0.50

Several proteins of the egg white (lysozyme, ovalbumin, conalbumin, ovomucoid) can be labelled biosynthetically, by incorporating tritiated aminoacids (tyrosine, tryptophan, arginine or lysine). Specific activities range from 1 to 100 mC/mM, depending on the protein and on the precursor. Starting from lysozyme tritiated by exchange, four labelled aromatic peptides were prepared whose specific activities seem to be greater than 10 mC/mM (studies in progress). The biosynthetic incorporation of tritiated aminoacids (arginine or lysine) occurs at a different rate in the proteins of the egg white and those of the yolk, and, for the latter, still differently in the hydrosoluble and insoluble ones. Isolation of pure labelled yolk proteins has not yet been achieved (studies in progress). Author

**N65-36425*#** Naval School of Aviation Medicine, Pensacola, Fla.

**A THRESHOLD CALORIC TEST: RESULTS IN NORMAL SUBJECTS**

Michael E. Mc Leod and Joseph C. Meek 9 Jul. 1962 11 p refs Joint report with NASA *Its* Rept. No. 72
(NASA Order R-47)
(NASA-CR-67539; AD-449842) CFSTI: HC $1.00/MF $0.50 CSCL 06P

A threshold caloric test procedure is described and the results of the test in 104 subjects are presented. The findings suggest that, in a young male population, the threshold responses to hot and cold caloric stimulation will be found within 1.5° C either side of body temperature. Threshold values greater than 1.5° C from body temperature may indicate an abnormal labyrinth. Evidence is shown which suggests that repeated threshold caloric irrigations produce little or no habituation. Author

**N65-36426*#** Naval School of Aviation Medicine, Pensacola, Fla.

**MAGNITUDE OF GRAVITOINERTIAL FORCE, AN INDEPENDENT VARIABLE IN EGOCENTRIC VISUAL LOCALIZATION OF THE HORIZONTAL**

Earl F. Miller, II and Ashton Graybiel 31 Jul. 1964 14 p refs Joint report with NASA *Its* Rept. No. 98
(NASA Order R-47)
(NASA-CR-67538) CFSTI: HC $1.00/MF $0.50 CSCL 06P

By holding the direction of gravitoinertial force (GIF) constant the effect of varying the magnitude of force from 1.0 to 2.0 G on egocentric visual localization (EVL) of the horizontal could be determined. Eight normal and two labyrinthine-defective (L-D) men served as subjects. The EVL of the horizontal was found to deviate from the gravitoinertial horizontal as a function of magnitude of the GIF. This magnitude effect tended to increase with the amount of body tilt from the gravitoinertial upright. The increase of GIF in the case of the L-D subjects resulted generally in an apparent rotation of the physical horizontal in a direction of the E- then A- phenomenon in contrast to the normal subjects who manifested ever increasing amounts of the E- phenomenon only. Based upon these findings and the assumption that the subjects differed under the experimental conditions primarily in otolithic function, the possible roles of otolithic and nonotolithic gravireceptor cues in EVL are discussed. Author

**N65-36429*#** Dunlap and Associates, Inc., Darien, Conn.

**APPARENT MOVEMENT PHENOMENA ON CRT DISPLAYS**

H. M. Bowen and G. V. Guinness Oct. 1964 76 p refs
(Contract NASw-954)
(NASA-CR-67527; DRD-64-131) CFSTI: HC $3.00/MF $0.75 CSCL 06P

The appearance of movement can occur on CRT's which use a short persistence phosphor and PRF rates between 20 and 50 cps. Analysis indicates that the apparent movement phenomena are due to movements of the eye; under suitable conditions, a stroboscopic interaction may be established between the succession of photic pulses and their impact at different locations on the retina. Symbols in an alphanumeric display can appear to jump or dance, depending upon the extent and type of eye movements. An experiment was conducted to estimate whether certain contemporary equipment which uses a P-31 fast phosphor and which evidences the phenomena in muted form is associated with lowered proficiency. We concluded that there is a high probability that when the apparent movement phenomena are present in sufficiently potent form performance will tend to degrade, especially when the observer's task is long and arduous. Author

**N65-36431*#** Naval School of Aviation Medicine, Pensacola, Fla.

**THE EFFECTS OF VISUAL DEPRIVATION ON ADAPTATION TO A ROTATING ENVIRONMENT**

Robert S. Kennedy, Gilbert C. Tolhurst, and Ashton Graybiel 18 Mar. 1965 39 p refs Joint report with NASA
(NASA Order R-93)
(NASA-CR-67537; NSAM-918) CFSTI: HC $2.00/MF $0.50 CSCL 06S

Three experiments were performed in the Slow Rotation Room to evaluate the influence of visual deprivation on several indices of adaptation to rotation. Data were obtained on tests of postural equilibrium, the Coriolis illusion, and canal sickness symptomatology. Reduction in the magnitude of the Coriolis illusion was observed whether vision was permitted or denied, but there was more variability in the latter condition. Equivalent or better postural performance was observed "without" vision, and fewer symptoms of canal sickness were observed in this mode. Author

**N65-36440*#** Naval School of Aviation Medicine, Pensacola, Fla.

**COMPARATIVE EFFECTS OF PROLONGED ROTATION AT 10 RPM ON POSTURAL EQUILIBRIUM IN VESTIBULAR NORMAL AND VESTIBULAR DEFECTIVE HUMAN SUBJECTS**

Alfred R. Fregly and Robert S. Kennedy 23 Mar. 1965 24 p refs Joint report with NASA
(NASA Order R-93)
(NASA-CR-67122; NSAM-920; AD-617754) CFSTI: HC $1.00/MF $0.50 CSCL 06S

As a means of better understanding the role of the vestibular organs in relation to ataxic responses to prolonged rotation, two contrasting groups of subjects were studied to: (1) determine quantitatively to what extent two visually-enhanced postural equilibrium test performances of labyrinthine defective subjects (L-D's) on a single rail of optimum difficulty become disturbed along the time axis of rotation (Experiment A); and (2) compare the performances of L-D's with normals in terms of postrotation effects as studied with a new standardized ataxia test battery (Experiment B). Rotation-induced ataxia was superimposed to an appreciable extent upon the previously present and characteristic vestibular ataxia in the L-D's (Exp. A), and (in Exp. B), upon cessation, there were significant decrements on all test battery performances of the normal group, whereas in the L-D group significant decrements were observed only on the two visually-enhanced tests. Author

**N65-36441*#** Solid State Radiations, Inc., Los Angeles, Calif.

**DEVELOPMENT OF A PERSONNEL DOSIMETRY SYSTEM FOR APOLLO Final Report**

Sep. 1965 39 p
(Contract NASw-415)
(NASA-CR-65157; SSR-IF1554-65) CFSTI: HC $2.00/MF $0.50 CSCL 06R

Investigation indicates that a dosimeter for the particle energy range and levels of interest of the Apollo mission can be fabricated within the envelope, weight, and power restrictions associated with a self-contained personal dosimetry instrument. Additional reduction in size and weight and greater ruggedization may be obtained through the conversion of the remaining subminiature printed circuit board components to thin-film hybrid circuitry. Design constraints and general systems design are discussed. A section on detailed system design considers the detector, amplifier, anticipated counting rates, pulse integration, readout circuit, DC to DC converter, and primary power source. Mechanical design data, test and calibration procedures, and schematic diagrams are included. M.W.R.

**N65-36506#** College of Southern Utah, Cedar City.

**THE EFFECTS OF X-IRRADIATION ON THE EMBRYOS OF INVERTEBRATE EMBRYOS**

Wesley Larsen [1965] 9 p
(Contract AT(11-1)-1030)
(TID-21877)

The effects of x radiation at dosages ranging from 50 to 12 000 R on the development of embryos of the ovoviviparous cockroach, *Blaberus craniifer*, exposed at various ages ranging from 1 to 52 days were studied. Approximately 3750 embryos were examined and microscopic sections made of those specimens exhibiting gross deformities, cessation of growth, or abnormalities in size. Embryos were found to become resistant to x radiation suddenly just prior to the stage of dorsal closure. Embryos that had passed this stage when irradiated continued to develop normally until dosages reached levels of 2000 to 5000 R. Gross abnormalities ranged from individual slightly retarded in growth to embryos represented by an amorphous mass. Typical abnormalities found are described. Tissue cultures of heart fragments, gut sections, and Malpighian tubules of Blaberus were prepared and survived for periods varying from 5 mo to 2.5 yr. The effects of x radiation at dosages up to 93 000 rads were studied, the use of function in heart fragments in testing various radioprotective chemicals, and the effects of oxygen and hypothermia on radiosensitivity were investigated. Results are summarized. Data are also included from studies of reactions of heart fragments from embryos of Blaberus to several vital strains and the effects of various growth hormones on the growth pattern of embryonic insect organ cultures. NSA

**N65-36553*#** Naval School of Aviation Medicine, Pensacola, Fla.

**THE EFFECTS OF EXPOSURE TO A ROTATING ENVIRONMENT (10 RPM) ON FOUR AVIATORS FOR A PERIOD OF TWELVE DAYS**

Ashton Graybiel, Robert S. Kennedy, Edward C. Knoblock, Fred E. Guedry, Jr., Walter Mertz et al 30 Mar. 1965 68 p refs Joint report with NASA *Its* Rept.-111
(NASA Order R-93)
(NASA-CR-67553; NSAM-923; AD-617756) CFSTI: HC $3.00/MF $0.75 CSCL 06S

Four carefully selected military personnel undergoing flight training were exposed to constant rotation at a speed of 10 RPM for 12 days in the Pensacola Slow Rotation Room. Environmental and working conditions simulated in many respects those which might obtain in a rotating orbiting spacecraft. The findings are discussed under three headings: clinical symptoms, clinical laboratory findings, and psychophysiological performance. The experiment has demonstrated that countermeasures in addition to adaptation are needed if there is immediate exposure to rotational velocities of 10 RPM and that the rotating room is a useful device for further exploration of vestibular and central nervous system mechanisms.
Author

**N65-36594*#** Naval School of Aviation Medicine, Pensacola, Fla.

**COMPARATIVE COCHLEAR RECONSTRUCTION IN MAMMALS**

Makoto Igarashi and Toshiko Yoshinobu 11 Jun. 1965 15 p refs Joint report with NASA *Its* Rept. No. 114
(NASA Order R-93)
(NASA-CR-67573; NSAM-931) CFSTI: HC $1.00/MF $0.50 CSCL 06C

The size, length, and shape of the cochleas have been compared in different mammalian species, with the use of graphic cochlear reconstructions. The ratio between the size of the cochlea and that of the skull generally decreases when the skull size increases. In order words, the size of the cochlea in small mammals is considerably larger. The number of cochlear turns increases when the cochlea protrudes into the well-pneumatized mastoid bulla instead of being embedded in the thick otic capsule. Author

**N65-36615#** Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

**STANDARDIZATION OF THYROID UPTAKE OF $I^{131}$ IN ACCORDANCE WITH THE RECOMMENDATIONS OF O.I.E.A. [NORMALIZACION DE LA CAPTACION TIROIDEA DE $I^{131}$ DE ACUERDO A LAS RECOMENDACIONES DEL O.I.E.A.]**

O. Degrossi, H. Forcher, and T. Watanabe 1965 13 p refs In SPANISH

(Rept.-148) CFSTI: HC $1.00/MF $0.50

Values are presented for thyroid absorption of iodine-131 for normal and thyropathic residents of more than ten years in Buenos Aires. They were obtained with a standardized absorption measuring technique using a collimator and shield of the International Atomic Energy Agency. In comparison with their standards, the values obtained had a difference of only 1%. The results were compared with values obtained by the same laboratory and those of other radioisotope laboratories in Buenos Aires using conventional collimation equipment, and with values observed in zones where the intake of iodine in the diet is considered normal and where endemic goiter exists. It was concluded that there is a relative need for iodine in the diet of people living in Buenos Aires. R.N.A.

**N65-36616#** Argentina. Comision Nacional De Energia Atomica, Buenos Aires.

**RADIOSTRONTIUM AND STABLE STRONTIUM IN THE BONES AND DIETS OF CHILDREN [RADIOESTRONCIO Y ESTRONCIO ESTABLE EN LOS HUESOS Y DIETAS DE LOS NINOS**

D. Beninson, E. Ramos, and R. Touzet 1965 15 p refs In SPANISH Presented at 2d Conf. on Fallout from Atomic Weapons, U. S. AEC, Germantown, Nov. 1964 *Its* Informe No. 149 CFSTI: HC $1.00/MF $0.50

The results of strontium-90 and natural strontium measurements in bone samples and diets of children are presented. The data show that in the first year most of the $Sr^{90}/Ca$ in a child's diet comes from milk. Measurements taken from 1961 to 1963 show that small children's daily intake of $Sr^{90}$ was a few picocuries and around a milligram of natural strontium. The results of $Sr^{90}$ measurements in bone samples are tabulated by age groups. Typical levels were in the order of 1 picocurie per gram of calcium. Natural strontium in bone seems to increase slowly with age, beginning with about 0.23 milligrams per gram of calcium and reaching the adult level of around 0.4 milligrams per gram of calcium between the second and third year of life. Using a simple model and diet and bone data, the discrimination factors for distinct age groups are estimated. The estimates from $Sr^{90}$ and natural strontium data agree and suggest that babies discriminate less against strontium than older children or adults. However, this work is of little importance in estimating the danger if the turnover of the skeletal bone is rapid during the first years of life. Transl. by R.N.A.

**N65-36617#** Argentina, Comision Nacional de Energia Atomica, Buenos Aires.

**FATE OF SPLEEN CELLS MARKED WITH $H^3$-SENSITIVITY IN IN VIVO CULTURES DURING SECONDARY RESPONSE OF ANTIBODIES [DESTINO DE LAS VELULAS DE BAZO MARCADOS CON $H^3$-TIMIDINA EN CULTIVOS IN VIVO DURANTE LA RESPUESTA SECUNDARIA DE ANTICUERPOS]**

Elmo E. Capalbo, T. Makinodan, and W. D. Gude 1965 15 p refs In SPANISH Submitted for Publication *Its* Informe No. 150 CFSTI: HC $1.00/MF $0.50

Labelled spleen cells were selectively cultured in hematopoietic tissue of strongly irradiated isologous receptors of rats. More labelled cells were detected in the spleen and bone marrow than in the lymphatic ganglions, thymus, liver, heart, or small intestine. The results suggest that spleen cells have a homing instinct in irradiated receptors. Studies of the prolific capacity of labelled lymphoid cells in the spleen receptor (labelled $H^3$ and counted by grains per cell) indicate that the maximum generation time for these cells can be cut in half when they are stimulated by an antigen, from 24 to 12 hours. This accelerated proliferation occurs 2 days before the appearance of the antibody in the circulation. The results also suggest that the mature plasmatic cells, following an antigen stimulation, are the result of 3 or 4 cellular divisions. R.N.A.

**N65-36664#** Army Medical Research Lab., Fort Knox, Ky.

**REPEATED VERTICAL SEMICIRCULAR CANAL STIMULATION DOES NOT HABITUATE HORIZONTAL NYSTAGMUS IN CAT**

George H. Crampton and James H. Brown 10 Feb. 1965 12 p refs Repr. from Acta Oto-Laryng., 1958 p 441–448 (Rept.-620; AD-616798)

A groups of cats were exposed to a series of angular accelerations about a vertical rotatory axis with the head tilted so that a synergic pair of vertical canals were in the plane of rotation, and then tested with the lateral canals in the plane of rotation. This group was compared with a second group that received only lateral canal stimulation, and with a third group that received neither lateral nor vertical canal stimulation. It was found that repeated acceleration of the vertical canals does not reduce that nystagmus elicited with the lateral canals accelerated in the plane of rotation. Author

**N65-36707#** Eidgenössische Technische Hochschule, Zürich (Switzerland).

**LETHALITY AND MUTATION RATES OF NEWLY LAID *DROSOPHILA*-EGGS AFTER X-RAY RADIATION AT VARIOUS OXYGEN CONCENTRATIONS [ABTOTUNGS- UND MUTATIONSRATEN NACH RONTGENBESTRAHLUNG FRISCH ABGELEGTER *DROSOPHILA*-EIER IN VERSCHIEDENEN SAUERSTOFFKONZENTRATIONEN]**

Franz Xaver Finsinger (Ph.D. Thesis) Leemann AG, 1964 23 p refs In GERMAN Repr. from Vierteljahrschr. Naturforsch. Ges. (Zürich), vol. 109, no. 3, 1964 p 175–195 (Rept.-3521) CFSTI: HC $1.00/MF $0.50

Newly laid eggs of Drosophila melanogaster in a nitrogen/oxygen mixture of varying oxygen levels were exposed to 1000 R 50-key X-radiation, and the effects on embryonic lethality, post-embryonic lethality, as well as the recessive, sex-related mutation lethality rate were observed. It was found that all three radiation effects increased with an oxygen content of 0 to 10 percent, leveled off, and remained steady throughout further increases up to 100 percent oxygen. Transl. by G.G.

**N65-36722#** Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.

**STUDY OF MONKEY, APE, AND HUMAN MORPHOLOGY AND PHYSIOLOGY RELATING TO STRENGTH AND ENDURANCE. PHASE VI: THE MUSCULOSKELETAL ANATOMY OF THE THORAX AND BRACHIUM OF A SQUIRREL MONKEY (SAIMIRI)**

William E. Edwards and Erika Fogg-Amed Jul. 1965 34 p refs Prepared under contract by W. E. Edwards, Columbia, S. C.

(Contract AF 29(600)-3466)

(ARL-TR-65-8; AD-468247)

The thoracic and brachial musculature of a female squirrel monkey (*Saimiri*) is described and illustrated by the photo-etching process. Comparisons with data from the literature on other platyrrhines and a few non-platyrrhine forms are provided. Author

**N65-36751*#** National Aeronautics and Space Administration, Washington, D. C.

**NORMAL STANDARDS OF THE SPHYGMOGRAM AND THE PULSE WAVE VELOCITY IN PERIPHERAL BLOOD VESSELS [NORMAL'NYYE STANDARTY SFIGMOGRAMMY I SKOROST' RASPROSTRANENIYA PUL'SOVOY VOLNY V PERIFERICHESKIKH SOSUDAKH]**

M. A. Abrikosova and V. L. Karpman Oct. 1965 12 p refs Transl. into ENGLISH from Patol. Fiziol. i Eksperim. Terapiya (Moscow), v. 3, no. 6, 1959 p 47–53

(NASA-TT-F-9578) CFSTI: HC $1.00/MF $0.50 CSCL 06P

The authors present data on the normal standards of the pulse wave and the velocity of its spread in vessels of the extremity. These data are necessary for an objective assessment of disturbances of peripheral circulation. The amplitude of the pulse curve, as well as the pulse wave velocity spread are variable for different vascular areas of extremities. An explanation is presented of the relative increase of the volumetric sphygmogram recorded at the upper level of the shin. Author

**N65-36753*#** National Aeronautics and Space Administration, Washington, D. C.

**PROBLEM CONCERNING DISTURBANCES OF THE LOCAL BLOOD CIRCULATION IN MAN UNDER THE INFLUENCE OF PROLONGED TRANSVERSE ACCELERATIONS [K VOPROSO O NARUSHENIYAKH REGIONARNOGO KROVOOBRASHCHENIYA U CHELOVEKA PRI DELITEL'NO DEYSTVUYUSHCHIKH POPERECHNO NAPRAVLENNYKH USKORENIYAKH]**

M. D. Yemel'yanov and E. S. Kotova Oct. 1965 8 p refs Transl. into ENGLISH from a paper presented at the 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965

(NASA-TT-F-9594) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The tolerance of the human organism for protracted and repeated transverse acceleration is investigated on the basis of changes in the cardiovascular system and specifically the retinal blood supply. Opthalmodynamometer and campimeter examinations as well as centrifuge tests showed phasic changes in vascular tonus, hyper- and hypotension of local character in the optic artery, and pathological changes in the retino-brachial index. Residual reactions in the form of dilatation of the retinal veins of as much as 50 $\mu$ over normal persisted for up to 11 days after the acceleration test. Author

**N65-36755*#** National Aeronautics and Space Administration, Washington, D. C.

**PROBLEM OF NORMALIZING LIFE-SUPPORT NOISES IN SPACECRAFT CABINS DURING PROLONGED FLIGHTS [K PROBLEME NORMIROVANIYA SHUMOV V KABINAKH KOSMICHESKIKH KORABLEY PRI DLITEL'NYKH POLETAKH]**

Ye M. Yuganov, Yu. V. Krylov, and V. S. Kuznetsov Oct. 1965 16 p refs Transl. into ENGLISH from Russian Presented at the 16th Intern. Aeronautical Congr., Athens, 13–18 Sep. 1965

(NASA-TT-F-9596) CFSTI: HC $1.00/MF $0.50 CSCL 06K

The effect of high-frequency noise (up to 3000 cps) on the auditory analysor of human subjects was studied, at a total noise level of 60–76 decibels and exposure to noise up to 60 days, to determine the threshold value for life-support noise in manned spacecraft. Factors such as relative isolation, hypokinesia, restrictive clothing, capsule living conditions, and monotony of sound were taken into consideration. Continuous noise for 72 hrs raised the auditory threshold by 15–20 db and ten-day experiments resulted in an increase by 20–25 db with functional disorders of the auditory analysor after 10 days. Intermittent noise (up to 7 hrs/day) showed a cumulative effect only after months or years. A noise of 50–60 phons background for spacecraft cabins was found acceptable as both upper and lower limit, with too low a noise level considered harmful to the neuropsychic system. Author

**N65-36756*#** National Aeronautics and Space Administration, Washington, D. C.

**PHYSIOLOGICAL REACTIONS OF MAN SUBJECTED TO ACCELERATIONS UNDER SPACE FLIGHT CONDITIONS [FIZIOLOGICHESKIYE REAKTSII CHELOVEKA PRI VOZDEYSTVII PEREGRUZOK VO VREMYA KOSMICHESKIKH POLETOV]**

P. V. Vasil'yev and A. R. Kotovskaya Oct. 1965 21 p refs Transl. into ENGLISH of a paper presented at the 16th Intern. Astronautical. Congr., Athens, 13–18 Sep. 1965

(NASA-TT-F-9597) CFSTI: HC $1.00/MF $0.50 CSCL 06S

The reaction of the human organism to acceleration under space flight conditions, in group flights on Vostok and Voskhod spacecraft, is analyzed with tabulated data on physiological factors. Pulse rate and respiration rose immediately before liftoff, to a maximum in the first few 10-sec periods at still moderate acceleration. On further acceleration, both values slowed down and reached pre-liftoff level at the end of the active phase. Subsequent decline in cardiac contraction frequency was slower than in ground centrifuge tests. Ground tests showed that tolerance for acceleration of 7–8 G, after complete bedrest at practical hypokinesis of 20 days, decreased to 4–6 sec as against 4–5 min in the controls, thus possibly explaining the observed reduced tolerance for acceleration on re-entry after prolonged space flight. Author

**N65-36759*#** National Aeronautics and Space Administration, Washington, D. C.

**CEREBRAL ANEMIA AND CONGESTION, MECHANICALLY PRODUCED IN ANIMALS BY VERTICAL POSITION OR BY GYRATORY MOTION [DE L'ANEMIE ET DE LA CONGESTION CEREBRALES PROVOQUEES MECANIQUEMENT CHEZ LES ANIMAUX, PAR L'ATTITUDE VERTICALE OU PAR UN MOUVEMENT GIRATOIRE]**

A. Salathé Oct. 1965 23 p refs Transl. into ENGLISH from Physiol. Exptl. (France), v. 3, 1877 p 251–272

(NASA-TT-F-9715) CFSTI: HC $1.00/MF $0.50 CSCL 06S

Protracted maintenance of various body positions, in its influence on blood circulation in the brain, was investigated in human and animal experiments, with recordings of respiration and cardiac stroke volume. Vertical position, with elevated head, resulted in progressive reduction of respiration and cardiac rhythm, ending in syncope and death due to bulbar anemia. Vertical position with the head downward resulted only in minor symptoms of congestion. Restoration to horizontal resuscitated the animals from apparent death. In centrifuge tests, position of the head toward the center produced death within a few minutes, while the animals survived for twice this time in the inverse position. Recumbent position in human subjects was found optimum for preventing syncope or suspension of cardiac action under extreme stresses. Author

N65-36768*# Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
**THE EFFECT ON THE CHIMPANZEE OF RAPID DECOMPRESSION TO A NEAR VACUUM**
Alfred G. Koestler, ed. Washington, NASA, Nov. 1965 114 p refs
(NASA Order T-272109)
(NASA-CR-329) CFSTI: HC $4.00/MF $0.75 CSCL 06S

CONTENTS:

1. PERFORMANCE A. G. Koestler, H. H. Reynolds, L. M. Barker, N. D. Catone, and G. L. Wilson 1–52 refs (See N65-36769 24-04)

2. PHYSIOLOGY L. M. Stephens, J. L. Hartman, O. F. Lewis, and J. M. Rhodes p 53–79 refs (See N65-36770 24-04)

3. EXPERIMENTAL SURGERY AND CLINICAL EVALUATION J. Fineg, D. C. Van Riper, P. W. Day, and J. R. Prine p 81–98 refs (See N65-36771 24-04)

4. PHYSICAL ENVIRONMENT T. D. Magnuson and T. L. Dobson p 99–106 (See N65-36772 24-05)

N65-36769* Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
**PERFORMANCE**
Alfred G. Koestler, Herbert H. Reynolds, Lewis M. Barker, Neil D. Catone, and Gordon L. Wilson *In its* Effect on the Chimpanzee of Rapid Decompression to a Near Vacuum Nov. 1965 p 1–52 refs (See N65-36768 24-04) CFSTI: HC $4.00/MF $0.75

Eight chimpanzees, used in nine separate tests, were decompressed from 179 mm Hg (breathing 100 percent $O_2$) to less than 2 mm Hg in 0.8 seconds and remained at this altitude from 5 to 150 seconds. After recompression to 179 mm Hg (again breathing 100 percent $O_2$), the subjects were kept at this altitude for 24 hours. Performance by all animals, on a complex operant schedule presented during and following rapid decompression, reached a baseline level of performance within a 4-hour post-decompression period. No central nervous system damage (as measured by performance) could be detected and all subjects survived in good health. Author

N65-36770* Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
**PHYSIOLOGY**
Loyd M. Stephens, John L. Hartman, Oliver F. Lewis, and John M. Rhodes (New Mexico Univ.) *In its* Effect on the Chimpanzee of Rapid Decompression to a Near Vacuum Nov. 1965 p 53–79 refs (See N65-36768 24-04) CFSTI: HC $4.00/MF $0.75

Cortical EEG, ECG, and respiration were recorded from immature chimpanzees before, during, and following rapid decompression to a near vacuum of less than 2 mm Hg. Subjects remained at this pressure altitude for up to two and one-half minutes. Visual analysis of the physiological parameters, as recorded on strip chart, was conducted and a correlation of these results to the animal's performance ability was attempted. EEG fast activity (10–12 cps) always preceded the end of total performance impairment. The continuous avoidance baseline level of response followed the return of EEG normalcy. Author

N65-36771* Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
**EXPERIMENTAL SURGERY AND CLINICAL EVALUATION**
Jerry Fineg, Donald C. Van Riper, Phillip W. Day, and James R. Prine *In its* Effect on the Chimpanzee of Rapid Decompression to a Near Vacuum Nov. 1965 p 81–98 refs (See N65-36768 24-04) CFSTI: HC $4.00/MF $0.75

Surgical procedures are outlined for implanting chronic cortical leads in the chimpanzee. Criteria for physical evaluation of the subjects are presented. All subjects showed slight neutrophilia, increased transaminase levels and facial edema, which were transient in nature and returned to normal within 72 hours after decompression to less than 2 mm Hg. There seems to be no lasting effect of rapid decompression exposure to a near vacuum. Author

N65-36894*# National Aeronautics and Space Administration, Washington, D. C.
**AEROSPACE MEDICINE AND BIOLOGY—A CONTINUING BIBLIOGRAPHY WITH INDEXES**
Sep. 1965 156 p
(NASA-SP-7011(15)) CFSTI: HC $1.00/MF $1.00 CSCL 06

Considerable emphasis is given to biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. References describing similar or actual effects on biological organisms of lower order are also included. Such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors receive appropriate attention. The emphasis is placed on applied research, but references to fundamental studies and theoretical principles related to experimental development also qualify for inclusion. R.W.H.

# 05 BIOTECHNOLOGY

**Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.**

N65-35784*# National Aeronautics and Space Administration, Washington, D. C.
**THEORETICAL PROBLEMS OF CONSTRUCTING ARTIFICIAL ECOLOGICAL SYSTEMS [NEKOTORYYE TEORETICHESKIYE VOPROSY POSTROYENIYA ISKUSSTVENNYKH EKOLOGICHESKIKH SISTEM]**
A. B. Rubin and A. S. Fokht Oct. 1965 12 p refs Transl. into ENGLISH of a paper presented at the 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965
(NASA-TT-F-9590) CFSTI: HC $1.00/MF $0.50 CSCL 06K

The creation of closed ecological systems for supporting life during prolonged space flights is discussed. The main approaches toward studying energy efficiency and operational stability of such a system are examined. Author

N65-35947# RAND Corp., Santa Monica, Calif.
**THE PROBABILITY OF VISUAL DETECTION OF RECONNAISSANCE AIRCRAFT BY GROUND OBSERVERS**
Doris J. Dugas Jun. 1965 66 p refs
(Contract AF 49(638)-700)
(RM-4562-PR; AD-619033)

An investigation of the ability of ground observers, unaided by optical or electronic devices, to detect visually each of six reconnaissance aircraft. Calculations are made for a variety

of conditions, in altitudes, speeds, and visibilities. Among several conclusions are: (1) the probability of visual detection falls off rapidly as aircraft altitude is decreased below 2000 ft; (2) increasing speed is an effective way to reduce detectability; (3) contrast is a critical factor in determining detectability but is difficult to predict or control. Author

**N65-36206#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.

**THE RELATIONSHIP BETWEEN VERTICAL ORIENTATION IN THE ROD AND FRAME TESTS AND VERTICAL ORIENTATION IN A COMPENSATORY TRACKING TASK**

R. Benfari and P. Vitale Jan. 1965 21 p refs

(RM-260J)

A study was made to uncover the relationships between an abstract perception test of verticality and a complex task having elements of a simple task as part of its properties. Its specific purpose was to examine relationship of styles of perception orientation to performance in a complex compensatory task that required the positioning of the body or some other reference to the gravitational vertical. Results showed that the body orientation and frame orientation perceptual styles had some relationship to error scores on the kinetic and static conditions of the tracking task; body-oriented subjects were less prone to make large control displacements than frame-oriented subjects. Both groups performed better with kinetic cueing than without it, and the lack of kinetic cueing caused a larger decrement in the performance of the frame-oriented subjects than in the performance of their body-oriented counterparts. G.A.L.

**N65-36226#** Naval School of Aviation Medicine, Pensacola, Fla.

**THE RELATIONSHIP BETWEEN PAST HISTORY OF MOTION SICKNESS AND ATTRITION FROM FLIGHT TRAINING**

Charles W. Hutchins, Jr. and Robert S. Kennedy 14 Jun. 1965 9 p

(NSAM-932; AD-620375)

The Pensacola motion sickness questionnaire (MSQ) was subjected to an item analysis using successful completion of the flight training program as the criterion for item selection. The scoring key that resulted was cross-validated on a new sample and a statistically significant correlation obtained. When included in the multiple prediction formulae used at this facility to predict training success, the MSQ made significant increases in the multiple validity of the formulae for predicting both successful completion of flight training and voluntary withdrawal from training. Author

**N65-36307#** Pennsylvania State Univ., University Park. Dept. of Psychology.

**CLUSTERING IN FREE RECALL AS A FUNCTION OF CERTAIN METHODOLOGICAL VARIATIONS**

Charles N. Cofer, Darryl R. Bruce, and Gerald M. Reicher (Mich. Univ.) Sep. 1964 22 p refs

(Contract Nonr-656(30))

(TR-3; AD-606975)

Three experiments involving category clustering in lists composed of high-frequency (HF) and low-frequency (LF) associates of the category names are reported. The major results were: (1) Block presentation augments clustering in both lists and augments word recall in HF but not in LF lists. (2) Word recall and clustering are higher in HF lists than in LF lists. (3) Duration of item presentation interval augments both clustering and word recall within limits. (4) An immediate recall augments or maintains clustering and word recall on a second recall, obtained after a short delay. (5) These findings and certain interactions are discussed with respect to the interpretation of recall of categorized lists. It is concluded that a coding hypothesis cannot do justice to all the findings. Associations between the category names and their instances or among the instances themselves are suggested as supplemental of alternative mechanisms. Author (TAB)

**N65-36432*#** Naval School of Aviation Medicine, Pensacola, Fla.

**COMPARISON OF AUTOKINETIC MOVEMENT PERCEIVED BY NORMAL PERSONS AND DEAF SUBJECTS WITH BILATERAL LABYRINTHINE DEFECTS**

Earl F. Miller, II and Ashton Graybiel 15 Feb. 1962 13 p refs Joint report with NASA

(NASA Order R-47)

(NASA-CR-67520) CFSTI: HC $1.00/MF $0.50 CSCL 06N

Autokinesis as perceived by nine normals and nine bilateral labyrinthine defective (L.D.) subjects was measured by a simple and highly reliable method. Each subject participated in two trials (one sitting, the other recumbent), each of about fifteen minutes duration. The results confirmed an earlier finding that the sensory organs of the inner ear are not essential for the perception of autokinetic movement. Furthermore, the amount of angular autokinetic movement was found to be significantly greater, on the average, in the labyrinthine defective group than in the normal group of subjects. These findings suggest that the sensory input from the organs of the inner ear under the conditions of the experiment tended either directly or indirectly to stabilize the fixation target in space. No significant differences in autokinesis were manifested between the two head (body) positions for either group. Author

**N65-36433*#** Bolt, Beranek, and Newman, Inc., Cambridge, Mass.

**STUDIES OF MANUAL CONTROL SYSTEMS Progress Report No. 7, 19 Jan.–18 Apr. 1965**

10 May 1965 15 p

(Contract NASw-668)

(NASA-CR-64578) CFSTI: HC $1.00/MF $0.50 CSCL 05H

A preliminary analysis of experimental data obtained in a study of manual control systems is presented. Three classes of experimental conditions were used to investigate the difference between single- and two-axis performance: (1) symmetric conditions, with the bandwidth of the input forcing function and the controlled dynamics the same on each axis, (2) mixed bandwidths, where the input bandwidths were dissimilar but the controlled dynamics were identical, and (3) mixed dynamics, where the input bandwidths were identical but the controlled dynamics were dissimilar. For each condition the hypothesis tested was that tracking performance in a given axis would not differ in the following two situations: (1) when that axis alone was tracked, and (2) when the two axes were tracked simultaneously. The differences between single- and two-axis performance on a normalized mean squared basis are summarized in tabular form. Results of mixed bandwidth experiments are also tabulated. C.T.C.

**N65-36724#** Minneapolis-Honeywell Regulator Co., Minn. Aeronautical Div.

**STUDY OF PILOT-CONTROLLER INTEGRATION FOR EMERGENCY CONDITIONS**

G. Cole, M. Bender, R. Shoquist, R. Santella, D. Lovinger, et al Wright-Patterson AFB, Ohio, Res. and Technol. Div. [1963] 193 p refs
(Contract AF 33(657)-7601)
(RTD-TDR-63-4092; AD-438820)

The objective of this program was to develop a design concept which will minimize catastrophic flight control failures through appropriate pilot-controlled integration. This report describes a systematic procedure composed of techniques within the field of flight control design, reliability, and human factors which yields a practical approach for effective design of an integrated pilot-controller system. Application of the procedure was made to an advanced vehicle mission phase as an aid to the study group in determining practicality of the approach. Areas where further advances of the study are limited by the state-of-the-art are pointed out as recommendations for future investigation. Author

**N65-36752*#** National Aeronautics and Space Administration, Washington, D. C.
**PROBLEMS IN EVALUATING THE PHYSICAL FITNESS OF COSMONAUTS (BASED ON MATERIALS OF THE VOSKHOD-1 AND 2 FLIGHTS) [VOPROSY OTSENKI RABOTOSPOSOBNOSTI KOSMONAVTOV (PO MATERIALAM POLETOV VOSKHOD-1 I 2)]**
P. I. Isakov, V. A. Popov, and L. S. Khachatur'yants Oct. 1965 11 p refs Transl. into ENGLISH from a paper presented at the 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965
(NASA-TT-F-9593) CFSTI: HC $1.00/MF $0.50 CSCL 06N

The physical fitness of astronauts under conditions of weightlessness and space environment was tested in orbital flight (Voskhod-1 and 2), including visual efficiency, postural-tonic reflexes, adaptation, reaction time to stimulus, and time required to perform assigned tasks. With increase in time spent in space, the reaction times returned, from an initial rise, to ground-level values. The resolving power of the visual analysor showed no major changes, while the visual working capability declined slightly toward the end of the flight. Operative memory (skill test) and reliability margins decreased in time, with the mean-square error in orbital flight being greater than in simulators on the ground. Absence of reference points is belived to greatly affect motor coordination in walks outside the capsule, unless using cables as support lines. Author

**N65-36764*#** Stanford Research Inst., Menlo Park, Calif.
**EXPERIMENTS IN TACTUAL PERCEPTION**
James C. Bliss and Hewitt D. Crane Washington, NASA, Nov. 1965 194 p refs
(Contracts NAS2-1679; AF 33(615)-1099)
(NASA-CR-322) CFSTI: HC $6.00/MF $1.25 CSCL 06B

Several psychological experiments, conducted in a study on tactile perception and communication, are described, along with the instrumentation and equipment used. Results of an experimental session, in which words, sentences, and paragraphs were transmitted by a tactile display, showed that subjects were able to read tactually from these displays at a rate of 20 words per minute after less than 20 hours of training. A specially designed tactile alphabet was developed, with such factors considered as learnability, edge effects, letter packing, and number of fingers used. It was found that tactually naive subjects were able to identify these letters correctly at a rate of about two random letters a second after 25 hours of practice. In studies of two-dimensional compensatory tracking with a continuous visual display, a discrete visual display, and a discrete tactile display, the performance with the tactile and discrete visual displays was about equal. A series of phenomenological observations and quantitative studies are also described. M.G.J.

**N65-36772*** Aerospace Medical Div. Aeromedical Research Lab. (6571st), Holloman AFB, N. Mex.
**PHYSICAL ENVIRONMENT**
Thomas D. Magnuson and Thomas L. Dobson *In its* Effect on the Chimpanzee of Rapid Decompression to a Near Vacuum Nov. 1965 p 99–106 (See N65-36768 24-04)
CFSTI: HC $4.00/MF $0.75

A decompression chamber, life support equipment, and other instrumentation are pictured and described. The equipment is used for studying the effects on the physiology, performance, and behavior of chimpanzees subjected to rapid decompression to a near vacuum with subsequent recompression. The conditions used for nine tests are tabulated. Temperature, relative humidity, and percent oxygen values are included in the tabulation. L.S.

**N65-36773*#** Bunker-Ramo Corp., Canoga Park, Calif.
**PILOT RE-ENTRY GUIDANCE AND CONTROL**
Albert B. Miller Washington, NASA, Nov. 1965 45 p refs
(Contract NASw-869)
(NASA-CR-331) CFSTI: HC $2.00/MF $0.50 CSCL 05H

The present paper considers some of the problems confronting the pilot during a manually controlled re-entry, and some of the areas where additional research could most profitably contribute to a more complete knowledge of manual control. The relationship between re-entry vehicle configuration and the nature and severity of the manual control maneuvers is discussed in terms of the energy available to control the vehicle, and the display-control relationship as they relate to the functions performed by the human operator. The importance of training through simulation is stressed and some of the areas where additional simulation studies are needed is pointed out. It is shown that the problem of escape continues to be a critical problem which requires considerable effort if a solution is to be attained. With regard to future needs, it is pointed out that simulation studies will continue to be one of the most important vehicles for research into manual control problems and that many more studies of the basic behavioral components of manual control are needed in order to develop more complete models of the human control process. Author

**N65-36786#** Honeywell, Inc., St. Paul, Minn.
**VISUAL SEARCH: EYE FIXATIONS AS DETERMINED BY INSTRUCTED TARGET CHARACTERISTICS Semi-annual Report, 1 Jan.–30 Jun. 1965**
L. G. Williams 12 Aug. 1965 7 p ref
(Contract Nonr-4774(00))
(T-125; AD-620336)

With prior instruction about single target characteristics, searcher's eye fixations tended strongly to fall on objects of instructed color, but tended less to fall on instructed size or shape. In general, when instructed about multiple target characteristics, fixations were related to a single characteristic, color if provided, otherwise size. Author (TAB)

**N65-36895*#** National Aeronautics and Space Administration, Washington, D. C.
**ELECTRICAL MORPHEUS [ELEKTRICNI MORFEJ]**
Oct. 1965 6 p Transl. into ENGLISH from Savremena Tehnika (Yugoslavia), no. 8, 1965 p 294–5
(NASA-TT-F-9743) CFSTI: HC $1.00/MF $0.50 CSCL 06B

Considerable success with a new electrical sleeping machine is stated by its users in Graz, Austria. The machine produces impulses of 36 to 230 cps of duration 0.4 to 1.4 μsec to 4 electrodes in a face mask; output maximum is 34 v. Daily treatment lasts from 1 to 2 hours and boasts good results for a wide spectrum of disorders. Author

# 06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

**N65-35812#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

**THERMAL DEGRADATION OF AN AROMATIC POLYPYROMELLITIMIDE IN AIR AND VACUUM. III: PYROLYTIC CONVERSION INTO A SEMICONDUCTOR**

S. D. Bruck Oct. 1964 35 p refs

(Contract NOw-62-0604-c)

(TG-615; AD-608766)

The pyrolytic conversion of [N,N'-(p,p'-oxydiphenylene) pyromellitimide] to semiconducting products is discussed as supported by data on electron paramagnetic resonance (EPR) absorption, specific resistivity, weight loss, density, and composition. Specific resistivities as low as 10 to 0.05 ohm-cm were obtained by vacuum pyrolysis between 620° and 850° C with a simultaneous increase in density to 1.65 g/cc. The region between 575° and 620° C was characterized by no appreciable weight loss, increase in density, and a sharp drop in the specific resistivity. These changes could be related to an internal reorganization of the polymer to semiconducting products, for which an activation energy of 25 ±3 kcal was calculated. The development of semiconduction in the pyrolysates occurs well below the graphitization temperature and with the retention of considerable quantities of nitrogen and oxygen. The results are explained in terms of increased mobility of current carriers facilitated by enhanced π-orbital overlap, which in turn arises from a molecular reorganization and fusion process at sufficiently high temperatures. Author

**N65-35833*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**A MASS SPECTROMETRIC ANALYSIS OF DC 704 DIFFUSION-PUMP OIL FRAGMENTATION**

H. Shapiro and B. N. Paxson Washington, NASA, Oct. 1965 9 p

(NASA-TN-D-3033) CFSTI: HC $1.00/MF $0.50 CSCL 07C

This report presents a mass spectrometric analysis of DC 704 diffusion-pump fluid. An attempt is made to assign a structural formula for each major task. A table listing empirical formulae for each mass number is presented as well as the fragment source from which it is derived. A unique vapor source and inlet system is described. Author

**N65-35905#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**POLYMERIZATION OF ACRYLONITRILE IN PRESENCE OF FURAN DERIVATIVES**

S. D. Sauranskaya, S. N. Trubitsina, and M. A. Askarov 22 Jul. 1965 12 p refs Transl. into ENGLISH from Karbotsepnyye Vysokomolekul. Soyedineniya, Sb. Statey (USSR), 1963 p 20–25

(FTD-TT-65-413/1+4; AD-618902)

The polymerization of acrylonitrile (AN) in the presence of furan derivatives—furfural, sylvan, and furfuryl alcohol—for the purpose of explaining their effect on the process of radical polymerization was investigated. Their inhibiting effect was shown in the process of polymerization, whereby furfural appeared to be the strongest inhibiting agent, even stronger than furfuryl alcohol and sylvan. The radiation-chemical initiation of AN polymerization was carried out in the presence of furan derivatives under the effect of gamma radiations at various dosages. It was shown that the given process affected a series of factors, and that the furan derivatives exerted an inhibiting effect on the reaction of polymerization; but with this case the strongest inhibiting agent appeared to be furfural. R.W.H.

**N65-35941#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**POLYORGANOSILOXANES—LIQUID BASE OF HIGH TEMPERATURE CONSISTENT OILS**

Ye. M. Oparina, G. S. Tubyanskaya, and R. I. Kobzova 30 Jun. 1965 16 p refs Transl. into ENGLISH from Khim. i Tekhnol. Topliv i Masel (Moscow), no. 1, 1964 p 32–38

(FTD-TT-65-322/1+2+4; AD-617947)

A comparative characteristic is given of polyorganosiloxane liquids, offering an interest in the role of liquid bases of high temperature consistent lubs. Polymethylsiloxane liquids as components of lubs, intended for operation at a temperature of 200° C, have the advantage in comparison with polyethylsiloxane liquid (physico-chemical properties, thermo-oxidation stability, antiwear properties) and with polymethylphenylsiloxanes (viscosity-temperature and antiwear properties). For silicon lubs intended for operation at a temperature of above 200° C, polymethylphenyl and polymethyl chlorophenylsiloxanes are recommended. Author

**N65-35964*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**PREPARATION OF LOW-CARBON-CONTENT IRON FOR USE AS AN ACCELERATOR FOR CARBON DETERMINATIONS**

Emery J. Merkle and Judson W. Graab Washington, NASA, Oct. 1965 5 p ref

(NASA-TM-X-1164) CFSTI: HC $1.00/MF $0.50 CSCL 07B

Accelerator material for induction-heating determination of carbon content in materials containing less than 50 ppm was prepared by utilizing the decarburizing effect of moist hydrogen to purify a commercial iron accelerator. The material has a low and uniform carbon content, which makes it especially useful for determinations of this type. Author

**N65-36086** Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.

**METALLOGRAPHY OF FUSED $UO_2$**

G. R. Cole *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 110–123 refs (See N65-36075 24-17) CFSTI: $6.00

(Contract AT(07-2)-1)

Microhardness and tarnishing behavior of microscopic impurities, together with X-ray and chemical techniques, were used to identify excess oxygen, metallic uranium, uranium carbide, and uranium nitride in arc-fused uranium dioxide. The shapes of the second-phase inclusions were of little aid to their identification. Microexamination of randomly selected chunks was employed to estimate the content and distribution of uranium and uranium nitride impurities in as-polished $UO_2$. Excess oxygen content was estimated by lineal analysis of micrographs of polished-and-etched $UO_2$; results agreed well with those obtained from weight gain on ignition to $U_3O_8$. Author

**N65-36130#** Argonne National Lab., Ill.
**PREPARATION OF METALS BY MAGNESIUM-ZINC REDUCTION. PART I: REDUCTION OF URANIUM OXIDES**
J. B. Knighton and R. K. Steunenberg Jun. 1965 19 p refs
(Contract W-31-109-ENG-38)
(ANL-7057) CFSTI: $1.00

The use of liquid magnesium–zinc alloy for the reduction of uranium oxides to the metal has been investigated. The uranium oxide was suspended in a flux composed of alkali and alkaline earth halides and reduced by vigorously mixing the flux–oxide slurry with zinc-5 w/o magnesium alloy at temperatures between 650 and 800° C. The reductions were conducted in an alumina crucible under an air atmosphere. As the uranium metal was produced, it dissolved in the liquid-metal alloy, from which it could later be recovered by vacuum distillation of the zinc and magnesium. The effects of flux composition, temperature, agitation, magnesium oxide loading in the flux, and uranium oxide particle size on the rate and extent of reduction were investigated. Under optimum conditions, over 99% reduction of $U_3O_8$ was achieved in periods as short as 10 min on the laboratory scale (4 g of uranium). Uranium losses inherent in the process are well below 1%. Author

**N65-36142#** California Univ., Livermore. Lawrence Radiation Lab.
**RELATIONSHIP BETWEEN CHEMICAL BONDING AND THE X-RAY SPECTRUM. STUDIES WITH THE SULFUR ATOM**
David Wesley Wilbur Aug. 1965 108 p refs
(Contract W-7405-ENG-48)
(UCRL-14379) CFSTI: $4.00

Changes in the X-ray spectrum caused by chemical bonding were discussed, and theories relating these changes to the electronic charge on the involved atoms were reviewed with emphasis on the emissions of the third-period elements. Such changes were studied on the sulfur atom in pure and 17 sulfur-containing compounds ranging from inorganic and organic sulfides to sulfates. Measurements were made using a plane, single-crystal, helium path spectrometer with proportional counter and pulse-height analysis for detection, and Soller slits for collimation. The $K_\beta$ line energies and widths exhibited large differences over the range of compounds studied, but there was no obvious correlation with bonding. A $K_\beta$ spectrum line about 13 eV lower in energy than the main $K_\beta$ emission was observed only in the 5 compounds of highest sulfur valence which had at least 2 oxygen atoms bonded to the sulfur atom. The intensity of this line was found to be negatively correlated with that of the main $K_\beta$ emission, reaching a maximum of one-third of the main $K_\beta$ intensity in $Na_2SO_4$. R.W.H.

**N65-36146#** Argonne National Lab., Ill.
**LABORATORY INVESTIGATIONS IN SUPPORT OF FLUID BED FLUORIDE VOLATILITY PROCESSES. PART VI: A. THE ABSORPTION SPECTRUM OF PLUTONIUM HEXAFLUORIDE, B. ANALYSIS OF MIXTURES OF PLUTONIUM HEXAFLUORIDE AND URANIUM HEXAFLUORIDE BY ABSORPTION SPECTROMETRY**
Martin J. Steindler and William H. Gunther Jan. 1964 18 p refs
(Contract W-31-109-ENG-38)
(ANL-6817) CFSTI: $0.50

The absorption spectrum of gaseous plutonium hexafluoride was determined over the range of wavelengths from 2000 Å to 26,000 Å, and molar absorbancy indices were calculated. A test of the spectral method of analysis of plutonium hexafluoride in mixtures of plutonium hexafluoride and uranium hexafluoride was made. The results indicate that plutonium hexafluoride may be determined in mixtures containing uranium hexafluoride by use of a spectral method although care is required to pretreat the cell windows to avoid reaction with plutonium hexafluoride. Author

**N65-36160#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**TWO-STAGE MAGNETIC MASS SPECTROMETER FOR THE ANALYSIS OF MINUTE ADMIXTURES**
V. I. Karatayev 15 Jun. 1965 8 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 10, 1963, p 65–66
(FTD-TT-65-213/1+2+4; AD-620130)

The use of mass spectrometry in the quantitative analysis of highly pure materials with minute amounts of foreign material of $10^{-4}$ to $10^{-8}$ percent is discussed and a compact two stage mass spectrometer designed to provide the desired sensitivity in such measurements is described. The instrument has one chamber and magnet common for both stages. Each stage represents a mass spectrometer with deviation of the ion beam by 180 degrees. The gain in sensitivity to small admixtures with the addition of the second stage amounts to $10^3$. Analysis of the isotopic composition of natural potassium showed that the analytical sensitivity to the content of $K^{40}$ amounted to $10^{-5}$ percent. E.E.B.

**N65-36172#** Imperial Coll. of Science and Technology, London (England). Dept. of Chemistry.
**PHOTOCHEMICAL REACTIONS IN THE ALKALI HALIDES Final Technical Report**
P. W. M. Jacobs and O. E. Facey Aug. 1965 36 p refs
(Contract N62558-3549)
(AD-620112)

The work described in this report is concerned principally with the kinetics of formation of the various centres formed in $HS^-$ and $DS^-$ doped KCl crystals and subsequent thermal bleaching of their absorption bands. The half-widths of the 193 and 255 mμ bands have been measured down to liquid helium temperature in an attempt to discover if the species responsible for the two absorption bands have a common ground state. Author

**N65-36183#** Army Missile Command, Huntsville, Ala.
**REDSTONE SCIENTIFIC INFORMATION CENTER. IMPROVEMENT OF SILICO-ORGANIC COMPOUNDS (TRIPHENYLSILOXY AND DIPHENYLCHLOROSILOXY BENZENES)**
Jun. 1965 14 p Transl. into ENGLISH from French Patent no. 1316401
(RSIC-427; AD-619051)

Object of the invention is a production process for thermally stable, silico-organic substances. These substances can be used in heat-exchangers, or for the transmission of mechanical energy by hydraulic systems. Author

**N65-36185#** Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
**STATIONARY STATE CRITERION FOR FREE RADICAL POLYMERIZATION FOR LINEARLY INCREASING REACTION TEMPERATURE**
Matatiahu Gehatia and John Broehl Feb. 1965 28 p refs
(AFML-TR-64-405; AD-614077)

The kinetics of free radical polymerization were treated theoretically under the assumption that the reaction temperature

increases at constant rate ($\dot{T}$ = const). From the Arrhenius relationships for the kinetic rate constants, approximate corresponding functions of time were derived, which transformed the kinetic equations accordingly. A differential equation describing the sum of the concentrations of all free radicals appearing in such a system was solved by approximation, and from the resulting series the conditions for the lower as well as the upper bound of the stationary state assumptions were obtained. Defining the required precision by a large number N, where the relative error caused by the stationary state assumptions cannot exceed the quantity 1/N, the stationary state criterion obtained could be expressed by the following inequality:

$$\frac{f\,[I]\,k_t}{k_d} \geq \frac{N^2}{64}$$

where f is the efficiency constant, [I], $k_d$ and $k_t$ are the functions of time defining the corresponding concentration of initiator, and the kinetic rate constants for initiator decomposition and termination. If the constant rate of temperature increase, $\dot{T}$, approaches zero, the reaction becomes a polymerization carried out at constant temperature. Under such conditions the derived criterion turns into another criterion valid for constant temperature. This new expression is identical to the corresponding formula derived previously. Author

**N65-36196#** Weizmann Inst. of Science, Rehovoth (Israel).
**RESEARCH ON MEASUREMENT OF PRESSURE INDUCED SHIFTS OF ABSORPTION LINES IN THE INFRARED SPECTRUM Final Scientific Report, Apr. 1, 1960–Dec. 31, 1964**
Feb. 1965 9 p refs
(Contract AF 61(052)-388)
(AFCRL-65-224; AD-614234)

Experimental and theoretical investigations were made of J-dependent pressure induced shifts of lines in infrared bands, and dispersion of gases in the infrared band was studied. Abstracts of 13 papers dealing with infrared spectroscopy are included. M.W.R.

**N65-36212#** Los Alamos Scientific Lab., N. Mex.
**THE GRAVIMETRIC DETERMINATION OF MOLYBDENUM IN URANIUM-MOLYBDENUM ALLOYS WITH α-BENZOINOXIME**
Ross D. Gardner, Carter H. Ward, and William H. Ashley 10 Apr. 1964 12 p refs
(Contract W-7405-ENG-36)
(LA-3058) CFSTI: $0.50

The α-benzoinoxime method for the determination of molybdenum has been applied and critically evaluated for the determination of molybdenum in uranium-molybdenum alloys. It was established experimentally that this method gave excellent results when applied to alloys containing 0.5 to 10% molybdenum. One hundred and twenty determinations on known solutions simulating uranium-molybdenum alloys in the above range showed an average recovery of 100.0% with a standard deviation of 0.3% relative. These knowns were analyzed over a period of several months by three different analysts. Author

**N65-36214#** Mound Lab., Miamisburg, Ohio.
**PYROLYSIS OF POLYMERS, A BIBLIOGRAPHY**
Roland W. Kohl 21 Sep. 1965 40 p refs
(Contract AT(33-1)-GEN-53)
(MLM-1271) CFSTI: $2.00

**N65-36239#** Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
**DETERMINATION OF ISOPHTHALIC ACID IN ALKYD-NITROCELLULOSE LACQUERS Final Report**
James R. Keiser 6 Aug. 1965 10 p refs
(CCL-183; AD-620154)

Alkyd resins made with isophthalic acid have recently been incorporated in lacquers, blended with nitrocellulose. No analytical methods have been reported in the literature for quantitatively determining the isophthalic content of such coatings. This report describes a rapid quantitative method for measuring the isophthalic acid content of nitrocellulose lacquers using an infrared absorbance ratio technique applied to solvent-free films of isolated vehicles. The method is dependent upon the previously determined nitrocellulose content. Author

**N65-36243#** Naval Research Lab., Washington, D. C.
**THE PRESENT STATUS OF CHEMICAL RESEARCH IN ATMOSPHERE PURIFICATION AND CONTROL ON NUCLEAR-POWERED SUBMARINES Fourth Annual Progress Report**
L. B. Lockhart, Jr. and V. R. Piatt, ed. 23 Mar. 1965 72 p refs
(NRL-6251; AD-614261)

Past and present research and development efforts on the atmospheric habitability of submarines are discussed, with emphasis on nuclear powered submarines. Progress is reported in the development of: (1) improved methods of sampling and analyses of atmospheres; (2) additives to decrease the degradation of monoethanolamine (MEA) in the $CO_2$ scrubber, and (3) a system for maximum utilization of the carbon in the main ventilation filter. Also discussed in the use of algae for oxygen production and carbon dioxide absorption; a study on water-thinned, fire-retardant paints; and a differentiation scheme for look-alike carbons and catalysts. G.G.

**N65-36247#** Florida Univ., Gainesville. Engineering and Industrial Experiment Station.
**SOLUBILITY AND DIFFUSIVITY OF HYDROCARBONS AND OXYGEN IN FUEL CELL ELECTROLYTES Final Report**
Keith E. Gubbins 30 Jun. 1965 67 p refs
(Contract DA-49-186-AMC-45(X))
(AD-620205)

Experimental measurements of the solubility of oxygen in KOH, $H_2SO_4$ and $H_3PO_4$ solutions, and of straight-chain, saturated hydrocarbons in phosphoric acid have been made over the full electrolyte concentration range. The diffusion coefficient of oxygen in KOH solutions at 25° C and in 85% $H_3PO_4$ solutions at 60° and 80° C are also reported. A correlation for the solubility of gases in phosphoric acid solutions has been derived by dimensional analysis, and shown to fit the measured values within the limits of experimental error. The correlation presented should enable the solubility of oxygen and hydrocarbons in 85–105% $H_3PO_4$ to be predicted with reasonable accuracy. The values of the diffusivity of oxygen in KOH have been shown to obey the theory of Ratcliff. Author

**N65-36250#** Air Force Cambridge Research Labs., Bedford, Mass. Meteorology Lab.
**RADIOCHEMICAL PROCEDURES FOR SELECTED RADIONUCLIDES IN ENVIRONMENTAL SAMPLES Instrumentation Papers No. 68**
Joseph Pecci, Peter J. Drevinsky, Edward Couble, Noreen A. Dimond, Marvin I. Kalkstein et al Jun. 1965 70 p refs
(AFCRL-65-410; AD-620219)

Methods are presented for the radiochemical analysis of precipitation, air-filter, and impactor-filter samples for fission products ($Sr^{89}$, $Sr^{90}$, $Zr^{95}$, $Ba^{140}$, $Ce^{141}$, and $Ce^{144}$), induced radioactivities ($Mn^{54}$, $Ag^{110}$, $W^{181}$, and $W^{185}$), high-altitude tracers ($Rh^{102}$ and $Cd^{109}$), cosmic-ray spallation products ($Be^{7}$, $Na^{22}$, $P^{32}$, $P^{33}$, and $S^{35}$), and natural radioactivity ($Pb^{210}$). Author

**N65-36251#** Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.

**SPECTROPHOTOMETRIC DETERMINATION OF NITRITE ESTERS AND SALTS IN COOLANT MEDIA Final Report**

Jules B. Counts 9 Aug. 1965 13 p refs

(CCL-184; AD-620153)

This report describes the spectrophotometric determination of nitrite esters and salts in coolant media. The method is based on the reduction of yellow ceric salts by nitrites, and the subsequent loss of color is employed as a means of estimating the percentage of nitrite. The absorption of visible light at 400 mμ by the reduced ceric solution is chosen as the wavelength for quantitative colorimetric measurements. After removal of dye this wavelength is free of interference from other antifreeze constituents normally found in current antifreeze compounds. Author

**N65-36254#** Oregon State Univ., Corvallis. Dept. of Chemical Engineering.

**ELECTRODE REACTIONS AND RATE PROCESSES IN NONAQUEOUS ELECTROLYTES Final Report, 16 Feb. 1961–30 Jun. 1965**

Robert E. Meredith Corona, Calif., Naval Ordnance Lab., 1 Aug. 1965 7 p

(Contracts N123(62738)26840A; N123(62738)32774A) (NAVWEPS-8825; AD-620296)

Research was concerned with two projects in nonaqueous electrochemistry. One project investigated high-temperature thermally activated voltaic cells with solid electrolytes; the other investigated low-temperature cells in liquid sulfur dioxide. Optimization of the fabrication of stabilized zirconia electrolytes, the vapor deposition of anode metals, and the evaluation of oxygen cathodes in cells at high temperatures were principal investigations in the thermally activated systems. Investigations of suitable reference electrodes, electrolytic conductivity, polarization parameters, and voltaic-cell investigations were made in liquid sulfur dioxide. Author

**N65-36260#** State Univ. of Iowa, Iowa City. Dept. of Chemistry.

**HIGH TEMPERATURE POLYMERS FROM 1,3-DIPOLAR ADDITION REACTIONS Quarterly Progress Report, 1 May–31 Jul. 1965**

John K. Stille 31 Jul. 1965 17 p refs

(Contract DA-11-070-AMC-832(W)) (QPR-2; AD-467161)

The synthetic investigations of two diamino acids, *m*-phenylenediglycine and N,N'-(4,4'-oxydiphenylene) diglycine, which are precursors to two bis-sydnones, have been carried out. Two model compounds, 1-3-diphenylpyrazole and 1,1'-diphenyl-3,3'-*p*-phenylenedipyrazole, have been synthesized from reactions of 3-phenyl sydnone with phenyl acetylene and *p*-diethynlbenzene, respectively. The latter reaction has been investigated with respect to reaction solvent in order to uncover optimum conditions for the polymerization. Three nitrile imine precursors, phenylhydrazide chloride, isophthaloylhydrazide chloride, and terephthaloylhydrazide chloride, have been synthesized. The reaction of phenylhydrazide chloride with *p*-diethynlbenzene in the presence of triethyl amine yields 1,1',3,3'-tetraphenyl-5,5'-*p*-phenylenedipyrazole. Author

**N65-36264#** Oregon State Univ., Corvallis. Dept. of Chemistry.

**INVESTIGATION OF SOLID STATE ELECTROLYTES Final Report, 1 Oct. 1962–31 Oct. 1964**

W. J. Fredericks and F. J. Keneshea, Jr. 3 Mar. 1965 47 p refs

(Contract AF 19(628)-1653) (ATCRL-65-403; AD-619823)

This research was undertaken to study the electrolyte-like behavior of impurity ions in solid solution. The diffusion of radioactive tracers in single crystals was studied by a microtome sectioning technique. The diffusion profiles for $Pb^{++}$, $Cd^{++}$ and $Ce^{+++}$ in KCl were obtained by measuring the activity in each section removed from the crystal. These data were analyzed by application of the Stasiw-Lidiard association theory. $Pb^{++}$ and $Cd^{++}$ were found to agree well with the behavior predicted by the theory. $Ce^{+++}$ did not show the expected concentration dependence. To agree with the present theoretical model $Ce^{+++}$ must be completely associated with a vacancy over the temperature range studied. Author

**N65-36266#** Illinois Univ., Urbana. Dept. of Chemistry.

**THE INFLUENCE OF IONIC AGGREGATION ON RATES AND PRODUCTS OF SEVERAL REACTIONS Final Report, Sep. 1963–Sep. 1965**

Stanley Smith [1965] 4 p refs

(Grant DA-ARO(D)-31-124-G366) (AROD-3657-2; AD-619913)

The proton magnetic resonance spectra of tetra n-butylammonium chloride, bromide, iodide, perchlorate, and picrate in nitrobenzene were obtained over the salt concentration range 0.005 to 0.25 molar. The position of the alpha-methylene protons of the cation is sensitive to concentration and the nature of the anion. Also, the rates of solvolysis of phenyldimethylcarbinyl chloride in ethanol and of phenyldimethylcarbinyl para-nitrobenzoate and thionbenzoate in ethanol and aqueous ethanol were determined. The solvolysis of these compounds was found to be sensitive to changes in solvent and substitution. The kinetics of the addition of methylmagnesium bromide to a substituted benzophenone and the alkylation of the sodium and potassium salts of some oximes in dimethylsulfoxide and tertiary butyl alcohol were also studied. The second order rate constants for the alkylations of the sodium salt of benzophenone oxime with isobutyl chloride at 25° C in dimethylsulfoxide were markedly concentration dependent. E.E.B.

**N65-36272#** Rock Island Arsenal Lab., Ill. Research and Engineering Div.

**DETERMINATION OF NICKEL IN PHOSPHATIZING BATHS BY THE X-RAY SPECTROGRAPHIC TECHNIQUE**

W. O. Crawford and W. D. Mc Henry Jun. 1965 15 p refs

(RIA-65-1448; AD-620141)

The purpose of the work outlined in this report was to develop a fast accurate method for the determination of nickel in phosphating baths. To accomplish this, basic nickel carbonate in known amounts was added to aliquots of phosphating solution. To prevent precipitation of solids during analysis, hydrochloric acid was added to the aliquots. A number of samples, taken from several different phosphating baths and stabilized in the manner described above, were subjected to

X-ray spectrographic analysis for nickel. The results obtained from these analyses showed that the method described in this report is a fast accurate method for the determination of nickel in phosphate baths. Author

**N65-36314#** Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
**FERROUS AMMONIUM SULFATE: CUPRIC CHLORIDE SOLUTIONS FOR DOSIMETRY OF A KILOCURIE COBALT-60 SOURCE**
E. A. Burke, C. M. Jimenez, L. F. Lowe, and M. Mulligan Jun. 1965 18 p refs *Its* Phys. Sci. Res. Papers No. 116
(AFCRL-65-470; AD-620230)

Aqueous solutions of ferrous ammonium sulfate with cupric chloride were studied as a means for determining the uniformity of the dose rate around a multikilocurie cylindrical array of cobalt-60. The solution selected to satisfy the requirements for dosimetry contained $5 \times 10^{-4}$ M ferrous ammonium sulfate and $5 \times 10^{-3}$ M cupric chloride in $10^{-3}$ N sulfuric acid. Spectrophotometric measurements of ferric ion were made in solutions brought to 0.15 N acid concentration, instead of the conventional 0.8 N, in order to minimize spurious oxidation. Using these solutions, no detectable variation in dose rate was found at symmetrically equivalent positions at the center of the cobalt-60 source. The average dose rate at each end of the cylindircal array proved to be 12 percent lower than that at the center. The dose rate was also less uniform at the ends, varying by ±4 percent from point-to-point. At a distance of fifteen inches from the center of the source array, the dose, rate decreased as the square of the distance. Author

**N65-36315#** Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center.
**A PROCESS FOR PRODUCING SILANES**
Goetz Koerner Jun. 1965 7 p Transl. into ENGLISH from German Patent no. 1162365, 6 Feb. 1964
(RSIC-430; AD-620736)

The invention involves a process for producing silanes containing hydrogen as well as OR-groups attached to the silicon atom. Halosilanes containing SiH-groups are made to react with alcohols or phenols of the formula ROH, where R designates an alkyl or aryl radical without active hydrogen; furthermore, the process is characterized by the fact that the reaction is performed in the presence of an acid acceptor which is insoluble in the reaction mixture. The reaction may be performed in the presence of an inert solvent. Author

**N65-36351#** Atomic Weapons Research Establishment, Aldermaston (England).
**A REVIEW OF EVALUATIONS OF NEUTRON CROSS SECTIONS AVAILABLE AT NOVEMBER 1964**
K. Parker Mar. 1965 23 p refs
(AWRE-0-13/65) CFSTI: HC $1.00/MF $0.50

A survey of evaluation work by laboratories is given followed by a tabular summary of the position for each chemical element and for certain isotopes and chemical compounds. This report is a revision of EANDC(UK)26. Author

**N65-36354#** Central Lab. TNO, Delft (Netherlands).
**ANALYSIS OF POLYPHENYL MIXTURES BY MEANS OF THIN-LAYER CHROMATOGRAPHY [ANALYSE VAN POLYFENYLMENGSELS MET DUNNELAAGCHROMATOGRAFIE]**
F. J. Ritter Brussels, EURATOM, 1965 14 p refs In DUTCH
(Contract EURATOM-096-63-1 ORGN)
(EUR-2236.n) CFSTI: HC $1.00/MF $0.50

Use of thin-layer chromatographic techniques for analyzing polyphenyl mixtures showed that a mixture of Bentone 38 and Celite offered interesting possibilities, and 1,2,4-triphenylbenzine and o,p-tetraphenyl can be seen in layers made of such mixtures. It was also found that a thin layer chromatogram with Bentone-Celite differs from that of aluminum oxide. The suggestion was made that the combination of thin layer chromatography on aluminum oxide and on Bentone/Celite theoretically offers possibilities for the quantitative analysis of tetraphenyl. Transl. by J.O.

**N65-36361#** Kernforschungsanlage, Juelich (West Germany). Institut fuer Physikalische Chemie.
**SELF-DIFFUSION IN LIQUID AMMONIA [SELBSTDIFFUSION IM FLUSSIGEN AMMONIAK]**
Th. Dorfmüller [1965] 40 p refs In GERMAN
(JUL-238-PC) CFSTI: HC $2.00/MF $0.50

The self diffusion in liquid ammonia was measured by simultaneous isotopic labelling with duterium and with $^{15}N(^{14}NH_2D$ and $^{15}NH_3)$. The capillary method was used. The diffusion coefficients were determined using the solution of the two Fick laws. Measurement temperatures could be maintained from −60 to +20° C with the deviation of ±0.05° C. The expressions for the temperature dependency at the saturation pressure of the ammonia from 20 to 8 torr was obtained. The maximum error of the individual measurements were estimated at ±2.5°. The measurement results are discussed on the basis of several hydrodynamic and kinetic theories. The pressure dependence of the diffusion coefficient, the relation between the activation energy for diffusion, viscosity, and dipole relaxation, the relation between the activation energy of the diffusion and the H binding energy, and the isotopic effects are described and discussed. NSA

**N65-36368#** United Kingdom Atomic Energy Authority, Harwell (England). Chemistry Div.
**THE PERFORMANCE OF A DIRECT CURRENT PLASMA JET WITH PARTICULAR REFERENCE TO THE ELIMINATION OF THE MATRIX EFFECTS DUE TO PHOSPHATE AND ALUMINIUM**
M. S. W. Webb, P. C. Wildy, and M. L. Wordingham Jul. 1965 13 p refs
(AERE-R-4990) HMSO: 2s 6d

The dc plasma jet has been found to have advantages over conventional flame photometry and atomic absorption spectrophotometry in that it is free from the matrix effects which cause suppression of the spectra of calcium and strontium in the presence of phosphate and aluminium. The coefficients of variation for the determination of calcium and strontium in tissues, urine, milk and vegetation are 3% whilst calcium can be determined in aluminium-containing rocks and ores with a coefficient of variation of 4%. Aqueous solutions of a calcium or strontium salt are used for standardization and the source is so stable that no internal standard is required. Author

**N65-36390*#** California Univ., La Jolla. Dept. of Chemistry.
**A REVIEW OF EVIDENCE FOR BIOLOGICAL MATERIAL IN METEORITES**
Harold C. Urey Jul. 1965 31 p refs Presented at COSPAR Meeting, Mar del Plata, Argentina, 17–19 May 1965
(Grant NsG-541)
(NASA-CR-67486) CFSTI: HC $2.00/MF $0.50 CSCL 07B

Findings on the similarity of the carbonaceous compounds, found in meteorites, to terrestrial biological material are reviewed, along with studies on the chemical composition of inorganic materials. The mineral and inorganic chemical

composition of the Orgueil, and Mighei meteorites, and the high iron group chrondites are discussed, and the mineral structure of the Orgueil meteorite is examined. A study reporting that material in the Orgueil meteorite was very similar to terrestrial fossil biological material is discussed, and rebuttals to the findings are presented. Details are also given on organic chemical studies of fatty acids, optical activity, prophyrins, nucleic acid bases, amino acids, free radicals, and hydrocarbons. It is concluded that the evidence strongly suggests biogenic material exists in these meteorites, and that it is probably indigenous. M.G.J.

**N65-36395*#** National Bureau of Standards, Boulder, Colo. Boulder Labs.

**A VAPOR PRESSURE EQUATION FOR OXYGEN**

J. G. Hust and R. B. Stewart 16 Feb. 1965 19 p refs

J. G. Hust and R. B. Stewart 16 Feb. 1965 19 p refs

(NASA Order R-45)

(NASA-CR-67504; NBS-8753) CFSTI: HC $1.00/MF $0.50 CSCL 07D

Several vapor pressure equations have been considered to represent the vapor pressure data of oxygen. These equations have been fitted to the selected experimental data. The deviations of the calculated and experimental also given. The selected equation is constrained to the critical, triple and normal boiling points. The selected vapor pressure equation reproduces the experimental data to within 0.01° K at the highest temperatures and 0.1° K at the lowest temperatures. Author

**N65-36420#** Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services.

**CATALYTIC PROPERTIES OF COMPLEX COMPOUNDS OF BORON TRIFLUORIDE**

M. I. Vinnik, G. B. Manelis, and N. M. Chirkov Nov. 1964 9p refs Transl. into ENGLISH from Probl. Kinetiki i Kataliza, Akad. Nauk SSSR [USSR], no. 10, 1960 p 285–290

(T-419-R) CFSTI: HC $1.00/MF $0.50

The polymerization of isobutylene and the decarboxylation of formic acid were investigated to determine the possibility of the reactions proceeding through the stage of the formation of coordination compounds with boron trifluoride reagents, i.e., aprotonic catalysis. Also, the nature and the amount of catalytic activity of coordination compounds of boron trifluoride with promoters are considered. In the reactions studied, the catalysis by complex compounds of $BF_3$ were found to be ordinary acidic catalysis. Aprotonic catalysis was not found in any of these reactions. It was shown that compounds of $BF_3$ with ether and with tetrahydrofuran are strong proton acids dissociating by way of the C–H bond. E.E.B.

**N65-36421#** Hôpital St. Pierre, Louvain (Belgium). Laboratoire de Recherches de la Clinique Medicale.

**INFLUENCE OF MOLECULAR STRUCTURE ON THE COMPOSITION OF STEROIDS IN SOLUTION BY AUTO-IRRADIATION [INFLUENCE DE LA STRUCTURE MOLECULAIRE SUR LA DECOMPOSITION PAR AUTO-IRRADIATION DES STEROIDES EN SOLUTION]**

P. Osinski Brussels, EURATOM, Jun. 1965 15 p In FRENCH; ENGLISH summary

(Contract EURATOM-040-63-9 RISB)

(EUR-2435.f) CFSTI: HC $1.00/MF $0.50

Investigated is the influence of molecular structure on the decomposition of steroids in solution by auto-irradiation, the steroids being deposited in different conditions with regard to solvent, temperature and radioactive concentration. The following remarkable facts emerged: if the oxygen atoms contained in the molecules tend to increase in number, they have an adverse effect on the storage of the steroids, irrespective of the position of the groups which carry this oxygen; the various structures of the A-nucleus do not seem to have any effect on the nature and degree of decomposition of the tritiated products; and in order to study the way in which the decomposition of tritiated steroids is affected by the structure of the side-chain, comparisons were made between hydrocortisone and cortexolone on the one hand and corticosterone and deoxycorticosterone on the other. These two pairs of steroids differ only by the presence of a hydroxyl group in the 11 position in the hydrocortisone and corticosterone molecules, this group being absent in the cortexolone and deoxycorticosterone molecules. The presence of the hydroxyl group is favorable to the storage of hydrocortisone, whereas on the other hand the decomposition of corticosterone is more pronounced than that of deoxycorticosterone. Author

**N65-36449#** Oak Ridge National Lab., Tenn. Isotopes Development Center.

**SEPARATION OF CARRIER-FREE $^{117m}Sn$ AND $^{111}In$ FROM A CYCLOTRON TARGET [VYDELENIE $^{117m}Sn$ I $^{111}In$ BEZ NOSITELYA IZ TSIKLOTRONNOI MISHENI]**

I. M. Rosman, Yu. A. Ryukhin, and A. F. Chachakov Mar. 1965 6p refs Transl. into ENGLISH from Radiokhim. (USSR), v. 6, 1964 p 500–502

(ORNL-TR-542)

Described is a method for separating radioactive tin and indium from a cadmium target irradiated with alpha particles. The method was used to determine the yield of the $^{114}Cd$ $(\alpha,n)^{117m}Sn$ reaction with a thick target. Considering the efficiency of the separation technique, a yield of $4 \times 10^{-6}$ was obtained. The measurement error was approximately 20%. S.C.W.

**N65-36476#** Argonne National Lab., Ill.

**THE STATE OF SODIUM DISSOLVED IN NaOH-MELTS, SUPPLEMENTARY NOTES TO PREVIOUS PAPER [UBER DEN ZUSTAND DES IN NaOH-SCHMELZEN GELOSTEN NATRIUMS, ZUSATZLICHE BEMERKUNGEN ZUR GLEICHNAMIGEN ARBEIT]**

F. Halla and H. Tompa [1965] 4 p refs Transl. into ENGLISH from Z. Anorg. Allgem. Chem. (Leipzig), v. 221, 1934 p 18–20

(ANL-TRANS-187)

The equilibrium constant for the reaction

$$NAOH + K = Na + KOH$$

which fluctuates between 0.77 and 0.31 is examined. A concept of the reaction is discussed which is compatible with previous work and allows the equilibrium constant variation to be narrowed and indicates an upper limit for the constant of the reaction

$$K_2O + Na = Na_2O + K.$$

E.E.B.

**N65-36480#** Stanford Research Inst., Menlo Park, Calif.

**SORPTION OF GASES ON METAL SURFACES IN ULTRA-HIGH VACUUM Annual Report, Feb. 15, 1964–Feb. 14, 1965**

B. Bergsnov-Hansen, N. Endow, and R. A. Pasternak 23 Mar. 1965 40 p refs

(Contract AT(04-3)-425)

(SRIA-425-4)

Study of the adsorption of nitrogen by molybdenum films was continued. For the low-temperature state, adsorption

occurs with a high sticking probability of about 0.5 and is only slightly dependent on coverage. The saturation amount is independent of pressure over the range of $10^{-8}$ to $10^{-4}$ torr and is of the order of a monolayer. Physisorption of xenon on molybdenum films at −196° to −186° C occurs with a high initial sticking probability of about 0.6. The equilibrium shows a significant pressure dependence of about 4 over a pressure range of $10^{-8}$ to $10^{-4}$ torr. For physisorption of xenon on glass the pressure dependence of the amount adsorbed was found to be about twice that found for molybdenum films. The heterogeneous hydrogen–deuterium exchange reaction on a molybdenum filament was also investigated at low pressure in a steady-state-flow system. It was established that the rate-determining step for the exchange reaction at elevated temperatures is the adsorption of $H_2$, HD, and $D_2$ on a clean surface. The sticking probability appears to be about the same for each, approximately 0.3, and independent of temperature. E.E.B.

**N65-36495#** California Univ., Livermore. Lawrence Radiation Lab.
**INFLUENCE OF IRON ON OXYGEN GRAIN-BOUNDARY DIFFUSION IN PERICLASE CRYSTALS**
D. R. Mc Kenzie (M. S. Thesis) 1 Sep. 1965 25 p refs
(Contract W-7405-ENG-48)
(UCRL-14215) CFSTI: $2.00

Grain boundary self-diffusion of oxygen in magnesium oxide was studied between 1658° C and 1743° C by combining proton activation of oxygen-18 with autoradiography. This technique was also used to study oxygen grain-boundary self-diffusion in iron-doped magnesium oxide between 1621° C and 1679° C. It was shown that ferric iron in concentrations of 350 atomic ppm or higher increased oxygen grain boundary self-diffusion in magnesium oxide at 1650° C by one order of magnitude. Activation energies were not calculated because of the short temperature ranges, 85° C and 58° C respectively, which were covered by the anneals. Author

**N65-36557*#** Notre Dame Univ., Ind. Dept. of Chemistry.
**EXPLORATORY STUDIES ON THE SYNTHESIS OF POLYMERIC AZINES Progress Report No. 8, 31 Jan.–15 Sep. 1965**
G. F. D'Alelio 15 Sep. 1965 33 p refs
(Grant NsG-339)
(NASA-CR-67558) CFSTI: HC $2.00/MF $0.50 CSCL 07C

This report covers the exploratory research on the synthesis and thermal studies of polymeric azines of the general structure, $[=HCArCH=N—N=]_n$, in which Ar represents a divalent aromatic moiety. As prototypes to the study of the azine polymers, the syntheses and study of selected axone monomers were also undertaken. The mechanism, kinetics and temperatures of decomposition of these monomers were investigated and reported. The conditions required for synthesis of high molecular weight black azine polymers were explored and they were successfully synthesized by melt polymerization techniques. Investigations as to the nature of their thermal behavior were initiated. It was shown that, upon thermal decomposition, the azine polymer yields a species of heat-resistant stilbene-type polymer. Author

**N65-36584#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
**EFFECT OF CHEMICAL COMBINATION ON THE SOFT X-RAY L EMISSION SPECTRA OF K, Cl AND S USING A STEARATE SOAP FILM CRYSTAL Technical Report, Aug. 1964–Mar. 1965**
David W. Fischer and William L. Baun Jun. 1965 22 p refs
(AFML-TR-65-139; AD-619393)

Major changes, caused by chemical combination, have been observed in the soft X-ray L emission spectra of potassium, chlorine and sulfur. For the simple chlorides the chlorine $L_{2,3}$ band at about 68 Å increases in wavelength as the ionic character of the chemical bond decreases. The sulfur L spectrum from elemental sulfur and the sulfides consists of a 3s and a 3d band and is in the 77 to 85 Å region. This spectrum changes considerably in the sulfates with the 3s band completely disappearing and the addition of a 3p band. The relative merits of the stearate soap film crystal for use in the 40 to 100 Å region are also discussed. Results were obtained using a flat crystal vacuum spectrometer with electron beam excitation and flow proportional counter. Author

**N65-36610#** Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
**CHROMATOGRAPHIC PREPARATION OF A MOBILE GAS PHASE [CROMATOGRAFO PREPARATIVO DE FASE MOVIL GASEOSA]**
Rustam T. Bonard and Gerardo J. Videla 1965 15 p refs Presented at the 11th Arg. Chem. Conf., Bahia Blanca, Nov. 1964 *Its* Informe No. 140 CFSTI: HC $1.00/MF $0.50

Fundamental characteristics are described of a gas chromotograph for the preparation of substances to be used in the synthesis of special organic compounds labelled with radioisotopes and for obtaining pure samples convenient for mass and infrared spectrometry and gaseous chromatography. In constructing this equipment, the problems resulting from the chromatographic preparation were kept in mind. Special attention was given to the injection and fast vaporization of large sample quantities and the recuperation of the separated fractions. The apparatus is of simple construction and operation. The problems of the gaseous chromatographic preparation were resolved resulting in an efficiency comparable to more elaborate commerical equipment. It has been successfully tested with diverse samples under various operating conditions. R.N.A.

**N65-36611#** Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
**SYNTHESIS OF LABELLED AMINO ACIDS. II: SYNTHESIS OF DL GLYCINE 1C-14 AND DL ALANINE-1C-14 [SINTESIS DE AMINOACIDOS MARCADOS. II: SINTESIS DE DL GLICINA 1C-14 Y DL ALANINA-1C-14]**
Mauricio F. Bühler, Aldo E. A. Mitta, and Juana B. de Lezerovich 1965 9 p refs In SPANISH *Its* Informe No. 142 CFSTI: HC $1.00/MF $0.50

The synthesis of the amino acids glycine and alanine labelled with carbon-14 in the carboxyl group is described. Both amino acids are labelled by ammonolysis of each of their corresponding alpha-bromo acids. In the case of alanine, the preparation of the intermediate is accomplished by brominating the acid obtained by the decomposition of the salt with hydrochloric acid dried at 200° ±20° C. In the case of glycine, the intermediate is prepared by brominating the acetal bromide obtained by distilling a mixture of sodium acetate 1-C-14 and benzoyl bromide. The preparation of the acetate of sodium 1-C-14, propionate of sodium 1-C-14, propionic acid 1-C-14 anhydride, bromo propionic acid 1-C-14, acetal bromide 1-C-14, alpha-bromo acetic acid 1-C-14; the ammonolysis of alpha-bromo acetic acid 1-C-14; and the preparation of DL alanine 1-C-14 are described. In addition the chromatographic and autoradiographic methods used in their analysis are described. Transl. by R.N.A.

N65-36612# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

**PREPARATION OF POTASSIUM FERROCYANIDE LABELLED WITH $^{59}Fe$ [PREPARACION DEL FERROCIANURO DE POTASIO MARCADO CON $^{59}Fe$]**

Roberto O. Marqués 1965 7 p In SPANISH; ENGLISH summary *Its* Informe No. 145 CFSTI: HC $1.00/MF $0.50

In potassium ferrocyanide, prepared by reduction of $Fe^{59}Cl_3$ and treatment with potassium cyanide, the chemical yield was higher than 90%. To test its radiochemical purity, a paper chromatography and electrophoresis method was developed for separating the possible active impurities such as ferricyanide, and ferric and ferrous ions. Ferro- and ferricyanide were separated from ferric and ferrous ions by ascending chromatography, with methyl ethyl ketone-hydrochloric acid (92:8) used as a solvent. Ferrocyanide was separated from ferricyanide, and ferrous or ferric ions by electrophoresis. Results showed that the radiochemical purity was greater than 99%. M.G.J.

N65-36618# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

**A NEW COLLOID LABELLED WITH Tc-99m [UN NUEVO COLLOIDE MARCADO CON Tc-99m]**

O. L. Garzon, M. C. Palcos, and R. Radicella 1965 8 p refs In SPANISH; ENGLISH summary Presented at 1st Symp. on Nucl. Med., Mendoza, Nov. 1964 *Its* Informe No. 152 CFSTI: HC $1.00/MF $0.50

The paper describes the preparation of Tc-99m labelled colloidal antimony sulphide. The 0.1 hydrochloric acid solution containing Tc-99m is added to an equal volume of $H_2S$ free, PVP stabilized, preformed antimony sulphide colloidal solution. After neutralization, the colloid is sterilized by heating at 120° C for 30 minutes. The colloidal particles retain more than 98% of the Tc-99m. Clear liver scannings are obtained by intravenous administration of the labeled colloid. Author

N65-36619# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

**TRITIATION OF FURFURAL [TRITIACION DE FURFURAL]**

Rafael H. Rodriguez Pasqués 1965 11 p refs in SPANISH; ENGLISH summary *Its* Informe No. 153 CFSTI: HC $1.00/MF $0.50

Tritiated furfural was prepared by irradiating arabinose with recoil tritons indirectly produced in a nuclear reactor. Furfural was subsequently derived from the tritiated arabinose by chemical way. The method is comparatively simple. The specific activity obtained was 56 microcuries per gram of furfural. Author

N65-36625# Polish Academy of Sciences, Cracow. Inst. of Nuclear Physics.

**ROTATIONAL DYNAMICS OF THE $NH_4$ GROUP IN AMMONIUM PERCHLORATE AND OF THE $H_3O$ GROUP IN HYDRONIUM PERCHLORATE [DYNAMIKA ROTACYJNA GRUPY $NH_4$ W NADCHLORANIE AMONU ORAZ GRUPY $H_3O$ W NADCHLORANIE HYDRONU]**

Janina Maria Janik 1964 63 p refs In POLISH; ENGLISH summary

(Rept.-360) CFSTI: HC $3.00/MF $0.75

The rotational dynamics of ammonium groups in $NH_4ClO_4$ and of hydronium groups in $H_3OClO_4$ was investigated using three types of neutron methods, i.e., the double differential scattering cross-section method with the application of a normal and inverted BE-filter, and the total neutron cross-section method. The results obtained were interpreted as giving evidence of a free rotation of $NH_4$ groups in $NH_4ClO_4$ and of a hindered rotation of $H_3O$ group in $H_3OClO_4$. For $H_3OClO_4$ the torsional frequency was measured and the barrier to rotation height was estimated. Author

N65-36627# Polish Academy of Sciences, Warsaw. Inst. for Nuclear Research.

**THE RADIATION INDUCED REACTIONS OF THE OXIDATION AND REDUCTION OF THE IRON IONS IN THE AQUEOUS SOLUTIONS CONTAINING THE ORGANIC SUBSTANCES. DIRECT OBSERVATIONS IN THE CONSTANT GAMMA-FIELD [RADIOLITYCZNE REAKCJE UTLENIANIA I REDUKCJI JONOW ZELAZA W ROZTWORACH WODNYCH ZAWIERAJACYCH ZWIAZKI ORGANICZNE. BEZPOSREDNIE OBSERWACJE W STALYM POLU PROMIENIOWANIA GAMMA]**

Roman Broszkiewicz 1964 93 p refs In POLISH; ENGLISH summary

(Rept.-579/XVII/C) CFSTI: HC $3.00/MF $0.75

The effects of the quality and concentration of an organic compound, and the concentration of the iron ions and sulphuric acid on the course of the radiation-induced reactions in the non-deoxygenated aqueous solutions have been investigated. The observations have been done by continuous measurements in the constant gamma-field. The results were analyzed, and conclusions on the mechanism of the processes have been proposed. Author

N65-36638# Warsaw Univ. (Poland). Dept. of Chemistry.

**THE INFLUENCE OF LIGHT (405 mμ) AND γ-RADIATION ON THE REDUCTION AND OXIDATION OF U(VI) AND U(IV) IONS IN AQUEOUS SOLUTIONS [WPLYW PROMIENIOWANIA OPTYCZNEGO I WYSOKOENER-GETYCZNEGO NA REAKCSE REDUKCSI I UTLENIANIA JONOW U(VI) I U(IV) W ROZTWORACH WODNYCH]**

Jerzy Sobkowski Nov. 1964 129 p refs In POLISH; ENGLISH summary

(Rept.-359/64/) CFSTI: HC $4.00/MF $1.00

The influence of light (405 mμ) and γ-radiation on reduction and oxidation of U (VI) and U (IV) ions has been investigated. Under the influence of light U (VI) ions undergo reduction to U (V) ions, which disproportionate to U (IV) and U (VI). The course of reaction was indicated by the changes of potential of the platinum electrode, immersed in the solution containing U (IV) and U (VI). It was observed, that the photoelectrochemical effect increased in the presence of complexing agents. The oxidation of U (IV) ions by γ-radiation was investigated by the polarographic method. The yields of oxidation of U (IV) ions in relation to their concentration in the solution were determined. At the beginning of irradiation the concentration of unstable U (V) ions increased linearly and after some time attained a stationary value. After the irradiation was discontinued, the concentration of U (V) decreased in consequence of disproportionation. On the basis of the obtained experimental data, the mechanism of oxidation of U (IV) ions by γ-radiation was proposed. Author

N65-36641# Eidgenössische Technische Hochschule, Zürich (Switzerland).

**OXIDATION MECHANISMS OF UNIVALENT ALCOHOLS WITH LEAD(IV) ACETATE [ZUM MECHANISMUS DER OXYDATION EINWERTIGER ALKOHOLE MIT BLEI(IV)-ACETAT]**

Daniel Hanser (Ph.D. Thesis) Juris-Verlag, 1964 84 p refs In GERMAN
(PROM.-3476) CFSTI: HC $3.00/MF $0.75

The lead(IV)-acetate oxidation of the monovalent, optical active aliphatic alcohol (+)-(4R)-4,8-dimethyl-nonanol-(1) in boiling benzene resulted in a complex mixture that contained a tetrahydrofuran derivative. Oxidation of the two C-5 epimeric 19-hydroxy-androstan groups of the two stereoisomeric alcohols 3,17-diethylenedioxide-19-hydroxide-5$\beta$-androstan (LXXXVIII) and 3,17-diethylenedioxide-19-hydroxide-5$\alpha$-androstan (CXXI) produced tetrahydrofuranes, $\alpha$-acetoxide ether, $\alpha$, $\beta$ unsaturated ether, fragmentation products, and O-acetyl-derivatives. Transl. by G.G.

**N65-36642#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**ON THE CATALYTIC OXIDATION OF GASEOUS BENZOL AT VANADIUM OXIDE CONTACTS [UBER DIE KATALYTISCHE GASPHASENOXYDATION VON BENZOL AN VANADIUMOXIDE-KONTAKTEN]**
Robert Eric Brauchbar (Ph.D. Thesis) Juris-Verlag, 1964 82 p refs In GERMAN
(PROM.-3489) CFSTI: HC $3.00/MF $0.75

Studies of benzene oxidation on vanadium oxide catalyzers established the vanadium-V-oxide reduction to $V_2O_{4.34}$ ($V_{12}O_{28}$) by kinetic measurements of the reaction mechanism on the surface of the catalyzer. The following activation energies were found:

| | |
|---|---|
| Reduction $V_2O_5 \rightarrow V_2O_{4.34}$ | A = 29.4 kcal/Mol |
| Oxidation $V_2O_{4.34} \rightarrow V_2O_5$ | A = 32.8 kcal/Mol |

A loop oxidation apparatus, containing a 50 cm long vanadium-molybdenum-phosphorus oxide catalyzer on a pumice base, obtained about 150 g maleic anhydride per liter benzene during one hour of operation. Transl. by G.G.

**N65-36643#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**ON THE LONGITUDINAL MIXING OF AQUEOUS SOLUTIONS IN REACTOR FLOW [UBER DIE LANGSMISCHUNG WASSERIGER LOSUNGEN IN DURCHSTROMTEN REAKTOREN]**
Hans Alfred Jenny (Ph.D. Thesis) Schmidberger und Müller, 1964 102 p refs In GERMAN
(PROM. 3493) CFSTI: HC $4.00/MF $0.75

Measurements of the longitudinal flow in various reactor geometries were used to determine the longitudinal mixing coefficient. A correlation between the coefficient and the linear flow velocity, the hydraulic radius of the fluid material, and the layer diameter of the fluid was established. The longitudinal mixing coefficient in turbulent flow was independent of the reactor length. It was concluded that the mixing flow in a pipe can be expressed through the longitudinal mixing coefficient function as well as by a function of geometric measurements. Transl. by G.G.

**N65-36644#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**X-RAY STRUCTURE ANALYSES OF SOME ORGANIC COMPOUNDS [RONTGENSTRUKTURANALYSEN EINIGER ORGANISCHER VERBINDUNGEN]**
Hans Peter Weber (Ph.D. Thesis) Juris-Verlag, 1964 75 p refs In GERMAN
(PROM.-3494) CFSTI: HC $3.00/MF $0.75

Azacyclododecan-hydrochloride crystals were obtained from aqueous solution and underwent X-ray analysis. Structural spectra along the [010] projection and along the [001] projection established the staggered dodecagon conformation. All bonds in the ring showed normal values of 1.54 Å. Crystals of 1,6-trans-dibromocyclodecan had a decagon structure; their two bromine atoms were bonded to the C atoms. Di-Patschuli-chromic-acid-ester crystals had a 140° Cr–O–C angle in the ester group. This wide oxygen valence seems to indicate that the oxidation of alcohols by chromic acid proceeds in the lineer form of Cr–O–C. Transl. by G.G.

**N65-36645#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**MANUFACTURE AND POLYMERIZATION OF CYCLIC ACROLEIN-ACETATES [UBER DIE HERSTELLUNG UND POLYMERISATION VON CYCLISCHEN ACROLEIN ACETALEN]**
André de Morsier (Ph.D. Thesis) Juris-Verlag, 1964 61 p refs In GERMAN
(PROM.-3513) CFSTI: HC $3.00/MF $0.75

The simple $\alpha$-$\beta$-unsaturated aldehyde, acrolein, and various diolés were used to produce cyclic acetales up to nine ring formations. The eight and nine ring formations were unstable and dissociated during polymerization at room temperature. Cyclic acroleinacetales did not polymerize, even in the presence of radical catalysts and ultraviolet radiation. Polymerization experiments established that the vinyl-group participation decreased with the higher reaction ability of the cyclic acroleinacetal ring. Transl. by G.G.

**N65-36646#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**ELECTRON STRUCTURE OF THE AZULENE CATION AND OF SIMILAR COMPOUNDS [UBER DIE ELEKTRONENSTRUKTUR DES AZULENIUM-KATIONS UND VERWANDTER VERBINDUNGEN]**
Werner Meier (Ph.D. Thesis) Juris-Verlag, 1964 75 p refs In GERMAN
(PROM. 3515) CFSTI: HC $3.00/MF $0.75

The fluorescent cation spectra of azulenes, guajakol-azulenes, and of the three guajakol-azulene sulphonic acids were measured in trifluoro acetic acid by spectroscope, and the pK' values for the unexcited and the excited states were determined. Electron spectra calculations for azulenes and benzoid azulenes established the electron affinity of the tropyl cations to −6.4 eV, and the affinity of the benzoid tropyl cations to −6.6 eV. Transl. by G.G.

**N65-36647#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**METHOD OF INTERPRETATION OF TETRA-VALENT NIOBIUM ELECTRO-RESONANCE-SPECTRA IN SOLUTIONS AND GLASSES [BEITRAG ZUR INTERPRETATION VON ELEKTRONRESONANZSPEKTREN DES VIERWERTIGEN NIOBS IN LOSUNGEN UND GLASERN]**
Marcel Lardon (Ph.D. Thesis) Juris-Verlag, 1964 62 p refs In GERMAN
(PROM.-3530) CFSTI: HC $3.00/MF $0.75

Values for the spin-Hamiltonian operator of the niobium (IV) ion at room temperature, and in glass at 77° K were calculated under the assumption of a strong, axisymmetric crystal structure. A formula for the G- and a-tensor spectra was formed with the transition probability considered, and

the low temperature spectra of niobium in methanol, ethanol, and isopropanol were calculated. It was shown that the half life spectra of the corresponding superfine structural lines were different in all three solutions. G.G.

N65-36648# Eidgenössische Technische Hochschule, Zürich (Switzerland).
**CONTRIBUTION TO THE INFORMATION ON INTERMEDIARY BY-PRODUCTS OF AROMATIC ELECTROPHILE SUBSTITUTION REACTIONS [BEITRAG ZUR KENNTNIS DER INTERMEDIAREN ZWISCHENPRODUKTE BEI AROMATISCHEN ELECTROPHILEN SUBSTITUTIONSREACTIONEN]**
Werner Koch (Ph.D. Thesis) Juris-Verlag, 1964 58 p refs In GERMAN
(PROM.-3563) CFSTI: HC $3.00/MF $0.50

The structure of the intermediate by-product from the reaction of 2-naphthol-6,8-disulfonic acid with bromide was established as a $\delta$ complex by resonance spectra. Reaction with iodine produced an unsymmetrical electron-donor-acceptor complex ($\pi$-complex). The obtained spectroscopic data were used to postulate the interrelation mechanism of the $\delta$ and $\pi$ complexes. Transl. by G.G.

N65-36687# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum Seibersdorf.
**ACTIVATION ANALYSIS DETECTION OF IMPURITIES IN ALUMINUM [AKTIVIERUNGSANALYTISCHE BESTIMMUNG DER VERUNREINIGUNGEN IN ALUMINUM]**
W. Kiesl, H. Sorantin, and H. Bildstein [1964] 16 p refs In GERMAN
(SGAE-CH-13/1964) CFSTI: HC $1.00/MF $0.50

A brief review of existing calorimetric and quantum counter methods to find impurities in aluminum is given. A new neutron activating analytical process is described that makes it possible to determine qualitatively the following impurities in the $10^{-4}$ to $10^{-8}$ percent range: dysprosium, gallium, hafnium, vanadium, nickel, manganese, copper, antimony, tin, scandium, chromium, cobalt, iron, zinc, and indium. This analytical process utilizes spectrum observations to determine the various half-life times of the impurity isotopes after irradiation, as well as wet-chemical methods of element separation. Transl. by G.G.

N65-36692# Portugal. Nuclear Energy Commission, Sacavem. Lab. of Physics and Nuclear Engineering.
**SPECTROPHOTOMETRIC OBSERVATIONS OF A CONCENTRATION OF OXYGENATED WATER BY CERIMETRY IN THE PRESENCE OF o-PHENANTROLINE FERROUS COMPLEX [OBSERVACAO ESPECTROFOTOMETRICA DO DOSEAMENTO DA AGUA OXIGENADA POR CERIMETRIA EM PRESENCA DE o-FENANTROLINA FERROSA]**
Manuel De Lima E Santos 1964 11 p refs In PORTUGUESE; ENGLISH summary Presented at the 27th Port.-Spanish Congr. for the Progr. of Sci., Bilbao, Spain, 20–24 Jul. 1964
(LFEN-NI-20) CFSTI: HC $1.00/MF $0.50

It has been shown that it is possible to increase the sensitivity of the cerimetric method of measuring the hydrogen peroxide concentration by measuring the absorbance of the o-phenantroline ferrous complex during the titration. A geometrical method is used to determine the equivalence point. Author

N65-36704# Nucklearni Institut Jozef Stefan, Ljubjana (Yugoslavia).
**PURIFICATION AND FILLING OF ELEMENTARY FLUORINE INTO STEEL BOTTLES [UBER DAS REINIGEN DES ELEMENTAREN FLUORS UND DESSEN EINFULLEN IN STAHLFLASCHEN]**
J. Slivnik, A. Šmalc, and A. Zemljič Jan. 1965 9 p refs In GERMAN Submitted for Publication
(NKJS-R-446) CFSTI: HC $1.00/MF $0.50

Described is an apparatus that removes impurities from electrolytic liquified fluorine by guiding the fluid repeatedly through cooling traps of −78° C and through a duct filled with granulated sodium fluoride. The purified liquid is poured into steel bottles under pressure. This procedure was used to fill a 10.5 liter steel tank with 99 percent pure fluorine at 8 atmospheres excess pressure during one day. Transl. by G.G.

N65-36708# Eidgenössische Technische Hochschule, Zürich (Switzerland).
**REACTIONS OF METAL CHLORIDES WITH LITHIUM HYDRIDE IN THE EUTECTIC LITHIUM CHLORIDE–POTASSIUM CHLORIDE [REAKTIONEN VON METALLCHLORIDEN MIT LITHIUMHYDRIDE IM LITHIUMCHLORID–KALIUMCHLORID–EUTEKTIKUM]**
Claude Robert Schnell (Ph.D. Thesis) Juris-Verlag, 1964 50 p refs In GERMAN
(PROM.-3501) CFSTI: HC $2.00/MF $0.50

Quantitative analyses of the reactions of metal chlorides with excessive lithium hydride from an eutectic LiCl/KCl mixture were performed by gas volume measurements. Hydrochloride was found in the reaction products of all alkaline-earth metal chlorides. Platinum and palladium formed new compounds, enriched with lithium. Rhodium and ruthenium reaction products contained free hydrogen. The preparation of a number of absolute anhydrous chlorides and their double salts is also discussed. G.G.

N65-36709# Eidgenössische Technische Hochschule, Zürich (Switzerland).
**COMPARISON OF THE CRYSTAL-CHEMICAL BEHAVIOR OF NIOBIUM AND TANTALUM IN CHEMICAL ANALOG OXIDE COMPOUNDS [VERGLEICH DES KRISTALLCHEMISCHEN VERHALTENS VON Nb UND Ta IN CHEMISCH ANALOGEN OXYDVERBINDUNGEN]**
Athanasios Panagos (Ph.D. Thesis) Athens, Nea Estia, 1964 75 p refs In GERMAN
(PROM.-3346) CFSTI: HC $3.00/MF $0.75

Compounds of tantalum pentoxide, and of niobium pentoxide with $Al_2O_3$, $Ga_2O_3$, $Cr_2O_3$, $Fe_2O_3$, $Rh_2O_3$, $In_2O_3$, and $Bi_2O_3$ were investigated by X-ray and spectrographic analyses for their crystalline structure characteristics. Evaluation of the obtained crystal formation curves showed that structural differences between some $A^{3+}NbO_4$ and some $ATaO_4$-compounds were caused by the stronger polarization of $Nb^{5+}$. Ternary mixtures of $A^{3+}$ formed higher symmetric structures with increased temperatures in the following order: $AlNbO_4$-types, wolframite-types, and the rutile-types. The presence of $A^{3+}$ in the $Bi^{3+}$ form led to the formation of ternary systems of the cubic pyrochlore type where A represents Al, Ga, Cr, and Fe, and B represents Nb, and Ta. The $AlNbO_4$ structure seemed to be limited to compounds of the $R_A/R_B << 1$ type. Rutile-type structures were found mostly when A was relatively similar to B. New structures were established for a variety of oxygen compounds. G.G.

**N65-36711#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EXTENSION TO CHROMATOGRAPH CHROM I FOR DOSAGING OF TRACES OF COMPONENTS CONCENTRATED IN A SMALL QUANTITY OF ADSORBENTS**
I. Kavan 26 Aug. 1965 6 p Transl. into ENGLISH from Chem. Listy (Prague), v. 58, no. 3, 1964 p 309–310
(FTD-TT-65-715/1+2+4; AD-470420)

The construction of an attachment to the chromatograph CHROM I is described. A simple extension was developed which enabled the dosaging of gas and vapor samples that were concentrated from a greater volume of gas on a suitable adsorbent outside of the chromatograph. The convenience of employing the dosager was investigated during the determination of naphthalene in coking gas in a concentration of less than 10 $mg/m^3$. An adsorbent was used, 0.05 g of Alusil, and a granulation of 0.1 to 0.2 mm was activated for 3 hours at 180° C. A diameter of 0.6 cm and 80 cm in length, with 15% Apiezon L on resorbent BLK, were obtained on the chromatographic column at 200° C and 1/10 sensitivities, with well reproduced results. The naphthalene wave was well developed and separated from other components of purified coking gas. R.W.H.

**N65-36721#** Battelle Inst., Frankfurt am Main (West Germany).
**SORPTION OF GASEOUS HYDROCARBONS AT FUEL CELL CATALYSTS OF THE PLATINUM METAL GROUP Final Technical Report, Jul. 1, 1964–Jun. 30, 1965**
Gerhard Wurzbacher 29 Jul. 1965 68 p refs
(Contract DA-91-591-EUC-3432)
(AD-467849)

Dispersion characteristics have been examined for Raney platinum samples prepared from a platinum–aluminum alloy. Initial specific surface area of 20 to 35 $m^2g^{-1}$ decreased to about 70% upon vacuum outgassing for 11 hours at both 100 and 200° C. No significant change was observed by additional heat treatment at 300° C. Surface area is reduced by about 20% by cleaning the catalyst surface by oxidation with gaseous oxygen, subsequent reduction with hydrogen, and evacuation at −150° C. The microporous structure of the catalyst is determined from the shape of the nitrogen adsorption–desorption isotherms. Study of the adsorption of propane at pressures of 0.1 to 100 mm Hg from 25 to 200° C indicates that both physisorption and chemisorption take place, but chemisorption increases with rising temperatures. Microgravimetric and mass spectrometric methods indicate that chemisorption increases with the degree of water coverage of the Raney platinum. Net weight of the specimen due to propane chemisorption depends on the degree of water coverage, but there is no weight change at about 1.3 monolayers of water. M.W.R.

**N65-36741#** Du Pont de Nemours (E.I.) and Co., Wilmington, Del. Electrochemicals Dept.
**STABILITY OF HIGH STRENGTH $H_2O_2$ Third Quarterly Report, Period Ending 30 Jun. 1965**
[1965] 39 p refs
(Contract AF 04(611)-10216; ARPA Order 24)
(AD-619179)

Studies of low temperature (−60C. to 0C.) storage of 90% and 98% hydrogen peroxide, both commerical (stabilized) and high purity (unstabilized) in passivated Pyrex glass were completed. Conclusions are the same as earlier reported. Work was devoted to improving the electron paramagnetic resonance equipment especially by the addition of a fast closing valve, thus damping out oscillations caused by stopping the flow, and allowing observation of events in the reaction of neutral solutions of $TiCl_3$ and $H_2O_2$ in the 1–100 m sec time range. This system is now an excellent tool to follow the radical growth and decay in peroxide reactions. To enable direct calculations of rate constants for these reactions, optical absorption studies on the products of the reaction have been begun. Irradiated "Teflon" EEP fluorocarbon resin containers allow storage of such hydrogen peroxide with between one-half and one-third the decomposition encountered in carefully passivated aluminum or Pyrex glass. TAB

**N65-36782*#** Mallory (P. R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science.
**RESEARCH AND DEVELOPMENT OF A HIGH CAPACITY NONAQUEOUS SECONDARY BATTERY Second Quarterly Report**
[1965] 56 p refs
(Contract NAS3-6017)
(NASA-CR-54407) CFSTI: HC $3.00/MF $0.50 CSCL 07D

Studies on lithium and copper electrodes are presented in the research and development of a high capacity nonaqueous secondary battery. Electrolytes and the lithium electrode are electrochemically characterized. Solvent purification and solute synthesis procedures were examined. Graphs of anodic E versus i, anodic E versus t, cathodic E versus i, cathodic E versus t, and cathodic E versus $it^{1/2}$ are included. Preliminary investigations of the solubility of copper salts in various electrolytes were conducted. A detailed examination is given of the mechanism of copper reduction in chloride media, the solubilization of copper salts in chloride media, and the solubilization of copper salts by impurities. A brief examination of the electrochemical behavior of sintered copper fluoride electrodes is included. C.T.C.

**N65-36787#** Princeton Univ., N. J.
**RESEARCH ON DIELECTRIC PROPERTIES AND THE STRUCTURE OF MATTER Quarterly Status Report, 1 Apr.–30 Jun. 1965**
Charles P. Smyth [1965] 6 p refs
(Contract Nonr-1858(09))
(QSR-37; AD-620163)

A computer program based on a Rigorous theoretical treatment was written and successfully used to calculate dielectric data, samples of Benzene, Heptane, Cyclohexane, Toluene, Dioxane, carbon disulfide, carbon tetrachloride and tetrachloroethylene were carefully purified and dielectric properties were measured at 2 MM, wavelength. Author (TAB)

**N65-36798#** Utah Univ., Salt Lake City. Inst. for the Study of Rate Processes.
**REACTION KINETICS, THE THEORY OF LIQUIDS, AND OPTICAL ROTATION Progress Report, 1 Oct. 1963–31 Mar. 1964**
Dennis Caldwell, Gilford A. Chappell, Sheng Hsien Lin, Donald Mc Laughlin, Tadashi Watanabe et al [1964] 8 p refs
(Grant DA-ARO(D)-31-124-G298)
(PR-4; AD-614083)

Research progress concerning optical rotation, thermodynamics of liquids, and thermal conductivity of liquids is briefly reviewed. A list is included of publications generated under the contract during the reporting period. TAB

**N65-36800#** Joint Publications Research Service, Washington, D. C.
**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 230**

29 Oct. 1965 36 p refs Transl. into ENGLISH of 2 articles from Hua-hsueh Tung-pao (Peking), no. 8, 14 Aug. 1965 p 13–19, 26–31
(JPRS-32616; TT-65-33095) CFSTI: $2.00

CONTENTS:

1. THE APPLICATION OF POLYALKYL (METHYL) HYDROGENSILOXANE AS WATER-REPELLENT C.-h. Hsia p 1–19 refs

2. THE TRANS EFFECT IN THE CHEMISTRY OF METALLIC COMPLEXES p 20–34 refs

**N65-36806#** Joint Publications Research Service, Washington, D. C.
**ON THE PHOSPHORYLATION OF FORMAMIDE**
P. I. Alimov and L. N. Levkova 21 Oct. 1965 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (Moscow), no. 10, Oct. 1964 p 1801–1807
(JPRS-32503; TT-65-32982) CFSTI: $1.00

Mixed formic-dialkyl phosphorus acid imides were prepared by reacting formamide or ethyl formamide with dialkyl phosphorochlorides. The formation of unsubstituted formylimidodialkyl phosphites in this reaction proceeded through the stage of pyrophosphorus acid ester formation and subsequent reaction with formamide. When dialkyl phosphorochloridate was reacted with ethyl formamide or unsubstituted formamide, the latter compounds underwent dehydration and formed tetraethyl pyrophosphate. Also, diisopropylphosphorochloride reacted in a similar manner with phenyl formamide to form an ester of pyrophosphorus acid. Further, an investigation of the reaction between some formyl n-ethylimidodialkyl phosphites with sulfur, nitrogen dioxide, and chloral showed that these reactions yielded formyl n-ethylimidodialkyl thiophosphates, formyl n-ethylimidodiisobutyl phosphate and formyl n-ethylimidodichlorovinyl phosphates. E.E.B.

**N65-36816#** Argonne National Lab., Ill.
**PREPARATION OF METALS BY MAGNESIUM-ZINC REDUCTION. PART II: REDUCTION OF THORIUM DIOXIDE**
A. V. Hariharan, J. B. Knighton, and R. K. Steunenberg Jun. 1965 19 p refs For Part I see ANL-7057
(Contract W-31-109-ENG-38)
(ANL-7058; ANL-7057) CFSTI: $1.00

The extent of reduction was determined as a function of time, amount and composition of flux, temperature, agitation, particle size of the oxide, and magnesium concentration in the alloy. The rate and extent of reduction were improved by the use of an argon atmosphere, although complete reductions were achieved in an air atmosphere. The reduction rates of thorium dioxide were slower than those obtained with $U_3O_8$, but the effects of changes in the flux composition were similar. Under optimum conditions, over 99% reduction of thorium dioxide was obtained in less than 4 hr, and product purities up to 99.7% were achieved. Four small-scale demonstration experiments were performed, in which thorium dioxide was reduced by zinc-magnesium alloy, the resulting liquid-metal solution was distilled to produce a thorium metal sponge, and the sponge was consolidated by arc-melting. It was also shown that thorium tetrafluoride is readily reduced by this method. Author

**N65-36835#** Case Inst. of Tech., Cleveland, Ohio.
**DEPOSITION OF CARBON ON DIAMOND SEED CRYSTALS Scientific Report No. 1, Jan. 1–Jun. 30, 1965**
John C. Angus 2 Jul. 1965 11 p ref
(Contract AF 19(628)-4785)
(AFCRL-65-497; AD-619292)

The experimental apparatus for the vapor deposition of carbon on diamond seed crystals has been constructed and leak tested; and the flow systems calibrated. Initial deposition of carbon, not on diamond substrates, has been accomplished. The computer programming for solution of the equilibrium compositions in high temperature hydrocarbon systems has been completed. The relative flow rates of $H_2$ and $CH_4$ to obtain low carbon supersaturations have been computed for several experimental regimes of interest. Author

**N65-36841#** International Business Machines Corp., Yorktown Heights, N. Y. IBM Thomas J. Watson Research Center.
**LOW TEMPERATURE VAPOR GROWTH STUDIES Final Report, 1 Jan. 1963–31 Dec. 1964**
Arnold Reisman Jul. 1965 104 p refs
(Contract AF 19(628)-2468)
(AFCRL-65-188; AD-619060)

In the GE-$I_2$-$H_2$-He vapor transport systems, $GaI_3$, $B_2H_6$ and $AsH_3$ have been employed as doping agents. Ga doped Ge layers were obtained at the $10^{17}$ carriers/cc level. Higher concentrations were found to be impractical using the HI transport reaction. As and B doped Ge films were grown via combined pyrolysis and disproportionation reactions. Using the hydrogen reduction of $GeCl_4$, it was found possible to grow "mirror" smooth Ge epitaxy of excellent bulk quality as low as 500° C on < 100 > oriented surfaces. An apparatus for the pyrolysis of $GeH_4$ in $H_2$ was constructed and films of Ge epitaxy on Ge were grown. An HI transport system was constructed and used to deposit single crystal ZnSe on Ge. A series of experiments has been designed which is intended to yield direct information of surface reaction rates while avoiding the complications of mass transport in the gas phase. The experiments designed for flow systems are currently being carried out on the HI etching of Ge reaction. A closed tube apparatus for the study of the kinetics of the $GeCl_4$ etching of Ge reaction is also described. Author

**N65-36845#** Wyandotte Chemicals Corp., Mich.
**SYNTHESIS OF LOW TEMPERATURE OIL RESISTANT URETHANE ELASTOMERS Final Report, 1 Jul.–31 Dec. 1963; 15 May 1964–15 May 1965.**
Seymour L. Axelrood and Wayne J. Lajiness [1965] 42 p refs
(Contract DA-20-018-ORD-24883)
(AD-619376)

The preparation of polyether urethane elastomers is described, and the effect of variation in polyether backbone, formulation and processing on their properties evaluated. Special attention was given to attaining elastomers with low temperature flexibility at −55° C, combined with < 10% ASTM No. 3 oil absorption when immersed 70 hours at 100° C. By using high molecular weight polyether polyols prepared for approximately equal molar quantities of ethylene oxide and tetrahydrofuran, these two target properties were achieved with only a slight compromise in tensile strength requirements. The key factor in the preparation of elastomers with good oil resistance was the concentration of the polar linkages and crosslinks between long, flexible polyether chains. The low temperature flexibility was attained by using the ethylene glycol-tetrahydrofuran polyols to provide the long, flexible polyether chains. Cast urethane-urea elastomers have been prepared from blends of high molecular weight polyethers and polytetramethylene ether glycols which meet the mechanical strength, compression set at 100° C, and low temperature flexibility at −55° C requirements of the contract. However, the oil resistance requirement was not satisfied. Author(TAB)

# 07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

**N65-35776*#** National Aeronautics and Space Administration, Washington, D. C.
**VISUAL SATELLITE OBSERVATIONS CONDUCTED BY STADE TRACKING STATION**
H. Kohnke Mar. 1965 9 p Transl. into ENGLISH of Visuelle Satellitenbeobachtungen Durchgeführt von Satellitenstation Stade" (W. Germany)
(NASA-TT-F-9286) CFSTI: HC $1.00/MF $0.50 CSCL 17H

Data for satellites visually observed at coordinates 53°35'20" N and 350°32'24" W (altitude above normal zero, sea level 7.5 m) are presented. The date observed, number of revolutions, catalog no., satellite name or code name, GMT time, magnitude, change in brightness, and tumbling half-period are tabulated. L.S.

**N65-35816#** Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Electrical Engineering Dept.
**PSEUDO-RANDOM DOT SCAN TELEVISION SYSTEMS**
S. Deutsch and P. Balaban Dec. 1964 55 p refs
(Contract AF 19(628)-3815)
(PIBMRI-1256-65; AFCRL-65-29; AD-616275)

The principal psychophysical requirements of the human eye are satisfied by a television frame frequency of 1 or 2 cycles/sec. To avoid flicker with such low frame rates, a pseudo-random dot scan is employed in conjunction with long-persistence phosphors. Experiments show that 15% dot flicker is tolerable. Ten systems are discussed, including a two-million-element picture with 4 mc/sec bandwidth; tape recording at 15 inches/sec; the continuous relaying of satellite pictures; short-wave transmission; phonevision; and very low frame rate applications that use a scan conversion system. Author

**N65-35848#** Rome Air Development Center, Griffiss AFB, N. Y. Communications Research Branch.
**DOPPLER AND MONOPULSE TRACKING RECEIVERS FOR THE ADAPTIVELY PHASED ARRAY. VOLUME II: AN ANALYSIS OF A MONOPULSE TRACKING RECEIVER**
James Tourdot May 1965 47 p refs
(RADC-TR-65-66, Vol. II; AD-617080)

The theory of operation of the monopulse tracking receiver is presented and a noise analysis is given for narrow-band signals. A system for deriving, from a monopulse feed, an error suitable for driving a servo system to control antenna position is described and analyzed. The principle emphasis is on the operation at low signal levels. Curves are derived describing the performance as a function of input signal levels. Also, the output low-frequency power spectrum of a square-wave modulated carrier in narrow-band Gaussian noise is derived and the gain of phase detector versus signal-to-noise ratio is included. E.E.B.

**N65-35863** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH AN INHOMOGENEOUS PLASMA**
I. V. Kamenev and V. A. Pogosyan *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 143–150 refs (See N65-35850 24-23)

The propagation of electromagnetic waves through a plasma is examined. The problem is formulated by considering a waveguide filled with an inhomogeneous plasma, and having ideally conducting walls. A cartesian system of coordinates is used, and the z axis is combined with the axis of the waveguide. Reflection and transmission coefficients are formulated, and a case of a periodically changing concentration is included. C.T.C.

**N65-35900#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**VISUAL–PHOTOGRAPHIC METHOD OF OBSERVING WEAK SATELLITES AND COSMIC ROCKETS**
B. A. Firago 24 May 1965 22 p refs Transl. into ENGLISH from Astrometriya (Leningrad), v. 23, no. 1, 1962 p 169–178
(FTD-TT-64-519/1+2; AD-618639)

Synchronously operating, fast-acting shutters on a standard camera with attached astronomical tubes were used to observe weak satellites. At the moment the shutter is opened, accompanied with a shrill noise, the position of the satellite is marked by dent on the screen of the tube filaments, and the position of the satellite on the negative is established by photograph of the reference star. Negative and tape of the printing chronograph together give the accurate satellite position with a mean error of 0.″5 for position coordinates, and of 0$^{s}$.01 for moment of time. G.G.

**N65-36107*** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
**EXPERIMENT T-1, REENTRY COMMUNICATION ON GEMINI III**
Lyle C. Schroeder, Theo E. Sims, and William F. Cuddihy *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 81–103 (See N65-36100 24-30)
CFSTI: HC $5.00/MF $1.25

A method of overcoming reentry blackout by injecting water into the flow field was demonstrated during the Gemini-3 mission. Significant levels of signal-strength increase during the early portion of the water-injection sequence were received on ultra-high telemetry (230.4-Mc), and ultra-high voice (296.8-Mc) frequencies. Enhancement of C-band beacon (5690 Mc) signal was observed during the latter portions of the water-injection sequence. Ultra-high frequency signals received during water injection exhibited an antenna pattern beamed in the radial direction of the water injection from the spacecraft. Author

**N65-36125#** Joint Publications Research Service, Washington, D. C.
**ON THE REFRACTION OF RADIO WAVES IN THE TROPOSPHERE**
N. A. Armand and M. A. Kolosov 12 Oct. 1965 15 p refs Transl. into ENGLISH from Radiotekhn. i Elektron. (Moscow), v. 10, no. 8, Aug. 1965 p 1401–1409
(JPRS-32361; TT-65-32851) CFSTI: $1.00

Standard working formulas have been derived for the determination of the angle of refraction of radio waves, caused by the troposphere and stratosphere. The formulas are true in the entire range of zenith angles. A method has been developed for the determination of the angle of refraction using ground meteorological measurements. The high correlation has been noted between the values of the angle of refraction and the index of refraction of the air near the earth's surface. Author

N65-36165# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Labs.
**RADAR DETERMINATION OF VELOCITY DATA FROM AN OBSERVATORY SATELLITE**
Sam C. Saunders Jun. 1965 22 p refs *Its* Mathematical Note No. 414
(DI-82-0447; AD-620194)

We obtain for several geometric situations the expression for the probability of insufficiently accurate data on the velocity of a surface target as a function of the parameters scan rate, nearest approach distance of an observatory satellite, the detection radii of the radar and the probability of detection per scan. The actual number of observations taken per pass of the satellite is random and in one instance we give explicitly the expectation of the probability of accurate data. This expectation can be calculated in other cases. This paper allows the determination of the capability of the radar necessary to produce an acceptable probability of obtaining accurate velocity information. Author

N65-36166# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**METHOD OF INCREASING RESOLVING POWER OF RADAR STATIONS AND A DEVICE FOR ITS ACCOMPLISHMENT**
Ya. D. Shirman 9 Aug. 1965 5 p Transl. into ENGLISH from Soviet. Patent no. 146803 (Appl. no. 461977/40, 25 Jul. 1956) 2 p
(FTD-TT-65-963/1+2; AD-620761)

Simplification of the method of increasing radar resolution in the invention being described is achieved by the shortening not of the sounding pulses but the pulses reflected from the target within the receiving device itself by means of a shortening filter in the form of a delay line, the taps to this line being interconnected. TAB

N65-36268# Raytheon Co., Norwood, Mass.
**TRANSAURORAL HIGH FREQUENCY RADIO PROPAGATION. VOLUME I: SIGNAL AMPLITUDE OBSERVATIONS Final Report, Feb. 1, 1962–Dec. 31, 1964**
Frank R. Roberts Apr. 1965 67 p refs
(Contract AF 19(628)-339)
(AFCRL-65-297(I); AD-620683)

Pulsed signals of 11 and 17 mc were transmitted over the transauroral path from Thule, Greenland to Norwood, Massachusetts. This path, which is perpendicular to the auroral zone, has its midpoint near Fort Chimo, Canada in the region of maximum auroral activity. At the Norwood receiving terminal, continuous recording of signal amplitude was performed over a 17-month period. Graphical presentations of circuit performance illustrate diurnal and seasonal variations, together with the dependence on geomagnetic activity. Normal propagation is F-layer controlled, although it departs markedly from classical predictions. Results of a theoretical investigation indicate that ionospheric layer tilts play no significant role in these departures. The occasional occurrence of anomalous modes is evident in the data. Absorption events coincident with reported shortwave fadeouts are noted. Author

N65-36270# North Electric Co., Galion, Ohio.
**STUDY OF AUTOMATIC ROUTING IN A SWITCHED SYSTEM UTILIZING SATURATION SIGNALING First Quarterly Report, 1 Jul.–30 Sep. 1964**
L. Robinson, H. Hambrock, R. Starr, and S. Sternung [1964] 37 p refs
(Contract DA-28-043-AMC-00342(E))
(Rept.-1; AD-620467)

Included are: A sample output from a checkout run of the Signal Saturation simulator, output statistic definitions and program changes presently being incorporated. The matter of priority and pre-emption is discussed with particular emphasis on in-band and out-of-band signaling and trunk reservation. Also included are: discussions of the direct routing simulator, the experimental program, including a method for establishing confidence bounds on the elementary statistics and figures of merit for systems comparison; plus an analysis of the switching speed used. Author

N65-36285# Joint Publications Research Service, Washington, D. C.
**INTENSITY OF RADIO WAVE SCATTER FROM ICE SURFACES**
V. I. Bykov 13 Oct. 1965 9 p refs Transl. into ENGLISH from Inform. Byul., Tsentr. Nauchn.-Issled. Inst. Morskogo Flota (Leningrad), no. 26, 1964 p 37–42
(JPRS-32378; TT-65-32868) CFSTI: $1.00

The intensity of radio wave scattering from a sea surface covered with ice was experimentally determined with the aid of airborne radar sets in the Arctic. Measurement methods are detailed, and it was pointed out that the diffusion coefficient for radio waves by ice floes is a complex function of the density, hummock density, height of surface irregularities, and other characteristics of the ice. The absolute value of the scattering coefficient lies within limits of −30 to −20 db for strongly hummocked ice, and −40 to −25 db for relatively smooth ice fields with slip angles of 5 to 30 degrees. It was noted that these coefficient values are approximately the same as the diffusion coefficient values produced during investigations of radio wave scattering from disturbed sea surfaces. The data produced on the scattering coefficient permitted an evaluation of the influence of the scattering signals from the ice surface on the radar visibility of small on-water objects. Calculations indicate that the noise caused by ice floes may be comparable in intensity with the useful signal from small ships and other small on-water objects. M.G.J.

N65-36405# British Telecommunications Research, Ltd., Taplow (England). Plessey Electronics Group.
**AN APPLICATION OF FLUID LOGIC TO TELEGRAPHY AS A RESEARCH VEHICLE, PAPER E1**
R. W. Bell [1965] 11 p Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

The development of a fluid logic device utilizing moving parts has been undertaken as a means of assessing the practicability of such devices, in particular, the overall performance in terms of reliability, speed of operation and general efficiency. The device in question is a telegraph station selection unit which is designed to operate in conjunction with a teleprinter, its function being to select for print out only those messages addressed to the teleprinter of which it forms part. The object of the paper therefore is to trace out the development of the device detailing the logic arrangement as an operation sequence, and to draw conclusions as to the feasibility of such units for practical use. Author

N65-36437*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
**EXTRATERRESTRIAL NOISE IN THE UHF REGION (300–3,000 Mc) (NOISE FROM THE MOON)**
Herbert Martinides Jan. 1965 35 p refs
(NASA-TM-X-56871) CFSTI: HC $2.00/MF $0.50 CSCL 09F

This survey is a result of a study of the available literature about extraterrestrial noise. It has been attempted to select the most reliable and significant data and sources through 1962, 1963. Numerical values about the extraterrestrial noise were considered here. For this reason any theory and speculation about this radiation has been omitted. The lack of experimental data is sometimes significant, but they are supplemented continuously by the great efforts on this subject at the present time. Noise sources were considered as the radiation of the moon, sun, galactic structures (interstellar hydrogen, and high energy electrons in the interstellar magnetic field), discrete sources and radiation from outside our galaxy. In particular the amount of noise, received by an antenna (2,000 Mc) pointed to the moon has been evaluated. Author

**N65-36472#** Joint Publications Research Service, Washington, D. C.
**PARALLEL DECODING**
B. S. Fleyshman 5 Oct. 1965 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 163, no. 6, 1965 p 1331–1333
(JPRS-32261; TT-65-32751) CFSTI: $1.00

Discussed are parameters for parallel decoding of a constant channel with independent noise as determined by a matrix of transition probabilities $p = \| p_i^j \|$ of input symbols i = 1,...,a in output symbols j = 1,...,b. Series decoding at a transmission rate substantially less than the channel capacity, and less than the tree-form random coding, leads to a stepwise increase in the average number of computations. Preliminary investigations of parallel decoding, and of block decoding based on the principle of maximum likelihood showed that full time machine computations are applicable for signal reception against a background of noise, when reception and decoding occur at different times. G.G.

**N65-36490#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**ELECTROMAGNETIC SCATTERING BY AN INHOMOGENEOUS PLASMA SPHERE**
P. E. Bisbing 9 Dec. 1964 45 p refs
(Contract AF 04(694)-486)
(Rept.-64SD295)

The mathematical analysis of electromagnetic wave scattering by radially inhomogeneous spherical objects is treated. Numerical integration of the differential equations for the separated radial wave functions has been carried out for the case of a plasma with an exponential electron density gradient. Results of parametric calculations of bistatic scattering cross sections indicate many interesting conclusions. For example, the total scattering cross section varies as the cube of ka, while the ratio of the forward scattering cross section to the backscattering cross section is exponential with ka, where a is the scale of the electron density gradient and k is $2\pi$ divided by the wavelength of the incident radiation. Backscattering is small at small ka; while at large ka, its behavior depends on the electron density and collision frequency. Author

**N65-36556*#** Stanford Research Inst., Menlo Park, Calif.
**THE DESIGN OF AN EXPERIMENT TO DETERMINE THE LIMITATIONS IMPOSED ON A MULTIPLE-APERTURE ANTENNA SYSTEM BY PROPAGATION PHENOMENA Third Quarterly Report, 1 Dec. 1964–28 Feb. 1965**
J. E. Adler, A. S. Dennis, R. T. Collis, F. G. Fernald, C. H. Dawson et al. Mar. 1965 63 p refs
(Contract NAS5-3974; SRI Proj. 5067)
(NASA-CR-67557) CFSTI: HC $3.00/MF $0.75 CSCL 09F

Work continued on the design of an experiment to determine propagation limitations on multiple aperture antennas. Work this period led to the following conclusions: Envelope detection will be used for amplitude measurements, a limiter and phase-locked loop will be used for phase measurements, and the tracking error signals will be synchronously demodulated. Radomes will be required to keep errors in angle-of-arrival measurements below 0.2 min of arc. The antenna must be circularly polarized. Sidebands will be demodulated by envelope detection of the phase-locked loop error signal. Kalman filtering will be used only for off-line data processing if at all. Liquid water along the propagation path can contribute refractivity changes as large as 100 N units. Meteorological instrumentation will include refractometers, cameras, rawinsondes, a liquid water content sensor, a radar, and the usual wind, temperature, humidity, and rainfall instruments. Monopulse antenna feeds at a lower frequency can be combined with a single feed at a higher frequency. R.N.A.

**N65-36560*#** Space Technology Labs., Redondo Beach, Calif.
**STUDY OF LUNAR LANDING SENSOR PERFORMANCE Interim Report No. 2**
J. E. Holland 31 Oct. 1963 59 p refs
(Contract NAS8-5205)
(NASA-CR-67569; STL-8411-6001-RU000) CFSTI: HC $3.00/MF $0.50 CSCL 17I

A trajectory study was made to determine the requisite sensor requirements for effecting a soft lunar landing by a multimission module on either an orbital descent or a direct-approach trajectory. For the orbital descent of the multimission module, changes in the sensor performance parameters for the beacon range acceleration and the inertial angular rate are easily accommodated. The problems involved with the radar antenna angular coverage and the associated solutions are discussed. Requirements for many rendezvous and docking-mission profiles are also tabulated. A simulation of the altitude tracking loop over the full dynamic range of three altitude profiles was achieved using a hybrid analog-to-digital computer. The need for both gain compensation and bandwidth switching was demonstrated and fulfilled in the simulation. The tracking loop parameters derived from the analysis were used and proved the basic validity of the analytical model. It was also shown that errors due to acceleration and compensation discontinuities will have to be considered in actual design. E.E.B.

**N65-36561*#** Space Technology Labs., Inc., Redondo Beach, Calif.
**STUDY OF LUNAR LANDING SENSOR PERFORMANCE Interim Report No. 1**
J. E. Holland 21 Jun. 1963 191 p refs
(Contract NAS8-5205)
(NASA-CR-67568) CFSTI: HC $5.00/MF $1.25 CSCL 17I

The necessary characteristics of sensors for soft lunar landings with and without beacon assistance were determined. For orbital descent on the moon, a liquid fueled vehicle with a relatively high thrust-to-weight ratio was examined using low altitude staging. It was determined that only two sensors were required for all mission profiles. Specifications for the sensors were determined, and the specifics of the sensors' design were established. The sensor requirements are tabulated for beacon assisted descents and nonbeacon-assisted descents. Also, beacon tracker characteristics are given, and the characteristics of extended range altimeters are discussed. The integrated beacon tracker–extended range altimeter is diagramed, and the characteristics of slant range tracker–velocity meter are tabulated. A reliability assessment is included. E.E.B.

**N65-36571#** Library of Congress, Washington, D. C. Aerospace Technology Div.
**RE-ENTRY COMMUNICATIONS STUDIES Surveys of Soviet Scientific and Technical Literature**
George Steblez 10 Sep. 1965 55 p Compilation of abstracts
(ATD-P-65-73)

An annotated bibliography is presented on Soviet developments in reentry communications. References are included on charged particle–plasma interactions; magnetoacoustic resonance; electromagnetic waves, wave scattering, and wave propagation in plasmas, electron distribution in plasmas, radiowave scattering by meteor trails, magnetohydrodynamics, and magnetic field effects on plasmas. R.N.A.

**N65-36576#** Hughes Aircraft Co., Culver City, Calif.
**PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH INHOMOGENEOUS SLABS Scientific Report No. 8**
A. T. Villeneuve Oct. 1964 39 p refs
(Contract AF 19(604)-8386)
(P64-116; AFCRL-65-16; AD-610838)

An approximation technique is considered for computing transmission and reflection coefficients for plane waves propagating through stratified slabs. The approximation uses a mapping of the given problem onto a similar, but exactly solvable problem. The approximate solution is then expressed in terms of the solution of the exactly solvable problem. As an illustration of the technique, the reflection and transmission coefficients of a transition layer are computed. Agreement between the exact and approximate values of the coefficients is good. Author

**N65-36579#** Raytheon Co., Norwood, Mass.
**TRANSAURORAL HIGH FREQUENCY RADIO PROPAGATION. VOLUME II: SIGNAL MODE ANALYSIS Final Report, 1 Feb. 1962–31 Dec. 1964**
Frank R. Roberts Apr. 1965 61 p refs
(Contract AF 19(628)-339)
(AFCRL-65-297(II); AD-620696)

High-frequency ionospheric propagation conditions over the 3820-km transauroral Thule–Norwood path were investigated to identify propagation anomalies and reveal their origins in terms of the geophysical environment. Three investigative techniques were employed: (1) step-frequency oblique-incidence sounding; (2) spectrum analysis of 17.7-mc signals originating from a frequency-stable transmitter; (3) and film-recording the multipath structure of 17.7-mc pulsed signals transmitted from a continuously rotating directional antenna. The third technique, in addition to providing relative time delays of multipath components, also furnishes the bearing of the signal transmitted from Thule. Propagation at the frequency of primary interest (17.7 mc) is predominantly via the classical one- and two-hop F-layer modes, although, during the summer months, multihop $E_s$ modes are observed, particularly at night. Several types of anomalous signals have been observed, one of which occurs quite regularly on magnetically quiet days and involves propagation over a path deviated to the west of the great circle; e.g., Thule bearing deviations as large as 90° have been observed. Author (TAB)

**N65-36598#** Bendix Corp., Southfield, Mich. Research Labs. Div.
**DEVELOPMENT OF AN ATMOSPHERIC SOUNDING DROPSONDE, GROUND RECEIVING AND DATA PROCESSING STATION. FIELD TEST REPORT Final Report**
R. A. Mullen and J. E. Lynott Feb. 1965 74 p refs
(Contract AF 33(600)-41821)
(Rept.-2537; AD-463716)

A general summary of the entire program is given, and the design and testing of the balloon-lifted dropsonde field test vehicle used in the flight demonstration of sensor feasibility are described. The mobile field telemetry station associated with the dropsonde in the field test is also described. The field test is discussed and the resulting data analyzed. Conclusions regarding the degree of success achieved in the sensor development are included. C.T.C.

**N65-36659#** Smyth Research Associates, San Diego, Calif.
**TRADEWIND DUCTING Final Report, Apr.–Nov. 1964**
E. D. Bowen, W. J. Fay, and D. R. Muñoz Griffiss AFB, N. Y., RADC, Feb. 1965 102 p refs
(Contract AF 30(602)-3363)
(SRA-425; RADC-TR-64-549; AD-614240)

The experiment was conducted to gain additional information on the Tradewind Duct mode for VHF communications over the 2500 mile path between Hawaii and Point Buchon on the central California coast. Medium power TV transmitters situated at Maui and Hilo were used as the source, and phase-locked receivers and medium to high gain antennas were used at the receiving site. Multiple frequencies between 60 and 212 mc/s were used. Data concerning the signal strength versus time, height gain at the receiving terminal, and meteorological data along the path were obtained. This report describes the seasonal and diurnal duty cycle of the ducting mode of propagation and the fading rate and fading depth of the signal received. Correlation between the transmission loss and duty cycle and the meteorological data yields information on the feasibility of predicting this propagation mode. The cumulative distributions of the basic transmission losses are displayed. Author

**N65-36661#** Centre National d'Etudes des Telecommunications, Issy les Moulineaux (France).
**STUDY OF VLF RADIATION BY USE OF A NIKE-CAJUN ROCKET**
Claude Renard and Christian Fayard 15 Apr. 1965 67 p refs
(Contract AF 61(052)-571)
(CNET-345-TC; AFCRL-65-564; AD-619250)

After the measurement principles have been exposed, a detailed description of the equipment is given and the telemetry results are analysed. In spite of an antenna effect on the loops, an approximate measure of the VLF field in the whistler mode between the D and E layers is given. An analysis of the propagation above Wallops-Island is carried out, which allows the development of the processing of the Doppler effect observed on the VLF wave received in the ionosphere. The electron density profile obtained between 70 and 100 km is analysed and shows two layers at 78 and 87 km. Author

**N65-36710#** Deutsche Versuchsanstalt für Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
**ON GENERALIZED CORRELATION- AND OPTIMUM FILTER-RECEIVERS FOR THE RECEPTION OF STATISTICAL OR STATISTICALLY DISTURBED SIGNALS IN INCREASED ADDITIVE BACKGROUND NOISE [UBER VERALLGEMEINERTE KORRELATIONS- UND OPTIMALFILTER-EMPFANGER FUR DEN EMPFANG STATISTISCHER ODER STATISTISCH GESTORTER SIGNALE IN ZUSATZLICHEM ADDITIVEM RAUSCHEN]**

Ch. Landgraf Jun. 1965 67 p refs In GERMAN; ENGLISH summary
(DVL-421; DLR-FB-65-28) CFSTI: HC $3.00/MF $0.75

This report gives an account of a generalization of the correlator receiver, which represents the optimum receiver if there are additional non-additive signal disturbances as they are observed in the case of multipath propagation through the atmosphere, multiple reflection or scattering in the troposphere, or in the case of radar observation of complicated targets with several scatter centres. Signals which have an inherent statistical nature, like the signals from radio stars, can also be received by the same methods. The generalized receiver structure is called estimator-correlator. In the present report only the general principles are explained. Additional statements that can be made in special cases (reception of narrowband signals, multiplicative noise, threshold signals) are not mentioned, and references to special applications are given only very briefly in the introduction. Author

**N65-36712#** Bendix Corp., Ann Arbor, Mich. Bendix Systems Div.
**MAGNETIC WINDOW PROPAGATION: A TECHNIQUE FOR PROPAGATION THROUGH A PLASMA SHEATH Interim Technical Report No. 2, 28 Feb.–31 May 1965**
James L. Surns 31 May 1965 35 p
(Contract AF 33(615)-2286)
(BSR-1138; AP-465811)

Vibration, shock, acceleration, and spin environmental tests were conducted on a magnetic window payload. Photographs, and block diagrams of the test setups are shown, and the environmental conditions for the various tests are given. The checkout equipment used for the tests are listed, and the data from the tests are both tabulated, and graphically presented. The payload passed all test conditions, which were essentially a simulated reentry environment of the payloads carrier vehicle during launch and reentry. L.S.

**N65-36714#** IIT Research Inst., Chicago, Ill. Technology Center.
**ENGINEERING STUDY FOR ELECTRICAL HULL INTERACTION Final Report, 2 Jan. 1964–2 Jan. 1965**
R. F. Elsner, M. Frazier, and S. Morissette 21 Jan. 1965 362 p refs
(Contract N123(953)-354 17A)
(IITRI-56013-14; AD-462979)

Laboratory testing has shown both non-linear junctions and magnetic materials to be potential sources of shipboard interference. A technique for mathematically approximating the characteristics of non-linear junctions was devised. Study of the differences between the theoretical expressions for non-linear products from junctions and magnetic materials led to the development of tests which could be used to distinguish the type of non-linearity under test. Tests performed on board the U.S.S. Rexburg uncovered several junctions which were contributing significantly to the interference environment. A new device for testing non-linear junctions in high-impedance circuits was designed, constructed and tested. An investigation of antenna non-linearities proved that steel antennas can generate non-linear signals whose strength is related to the fundamental current density in the antenna. An experimental low-non-linearity dummy load has been developed. Author

**N65-36717#** Göttingen Univ. (West Germany). Physiological Inst.
**ABSORPTION AND TRANSMISSION OF ELECTROMAGNETIC WAVES. PHASE D: COMBINATION OF MAGNETIC LAYER- AND WEDGE TYPE ABSORBERS. Final Report**
E. Schunk 31 Dec. 1964 42 p refs
(Contract AF 61(052)-667)
(AD-463718)

Electromagnetic wave absorbers have been developed consisting of thin ferrite layers with magnetic losses combined with wedge type absorbers. The absorber combinations work up to higher frequencies than pure ferrite layer absorbers and have smaller total thickness than pure wedge type absorbers. Author (TAB)

**N65-36749#** Oslo Univ., Blindern (Norway). Inst. of Cosmic Physics.
**MULTI-CHANNEL EQUIPMENT FOR RECORDING VLF-EMISSIONS IN THE FREQUENCY-RANGE 2–16 Kc/s Scientific Report No. 1**
L. Harang, R. Larsen, and J. Skogtvedt 25 Apr. 1965 14 p refs
(Contract AF 61(052)-811)
(AFCRL-65-512; AD-620870)

The preliminary results of recordings of VLF-emissions in the frequency range 2–16 kc/s are presented, using five-channel equipment with center frequencies at 14.7, 12.3, 7.2, 4.7 and 2.3 kc/s. The power spectral densities of typical burst events were measured at each of the five center frequencies. At the lowest frequency no amplitude, or very faint amplitudes appeared. In the bands 4–7 kc/s the densities were of the order $10 \times 10^{-16} W/m^2c$. On 15 kc/s the density had increased to $60–70 \times 10^{-16}$ $W/m^2c$, there is thus an increase of 3-5 times. The center frequency of the emissions therefore lies at a higher frequency than 15–20 kc/s. Author

**N65-36750*#** National Aeronautics and Space Administration, Washington, D. C.
**SATELLITE OBSERVATIONS CONDUCTED BY THE STADE TRACKING STATION**
H. Köhnre Jan. 1965 4 p Transl. into ENGLISH of "Visuelle Satellitenbedbachtungen durchgeführt von Satellitenstation Stade" (W. Germany)
(NASA-TT-F-9242) CFSTI: HC $1.00/MF $0.50 CSCL 17H

Data for satellites visually observed at coordinates 53° 35'20" N and 09° 27'36" E (altitude above normal zero; sea level 7.5 m) are presented. The date observed, number of revolutions, catalog number, satellite name or code name, GMT time, magnitude, and light change tumbling are tabulated. L.S.

**N65-36765*#** Stanford Univ., Calif. Stanford Electronics Labs.
**A PHASE LOCKED DUAL CHANNEL SPACECRAFT RECEIVER FOR PHASE AND GROUP PATH MEASUREMENTS**
R. L. Koehler Washington, NASA, Nov. 1965 153 p refs
(Contract NAS2-1759; Grant NsG-329)
(NASA-CR-323) CFSTI: HC $5.00/MF $1.00 CSCL 09F

Described is a 49.8 and 423.3 mc phase locked receiver for group and phase path measurement aboard the Pioneer interplanetary spacecraft. The experiment used two high power ground based transmitters and a 150 foot parabolic antenna to transmit phase modulated signals to the receiver. The receiver maintained phase lock for 10 hours before skipping

cycle in the 49.8 mc channel at 130 dbm with 8000° K cosmic noise, and in the 423.3 mc channel at 137 dbm with 100° K noise. Also discussed is the receiver performance and a detailed block diagram, followed by schematics with a description of their operation. Reasons for some of the design decisions are included, as well as a discussion of the areas for improvement. The calculated and measured phase lock loop performance are compared. Low residual magnetism construction techniques and other construction details are included. R.W.H.

**N65-36815#** Illinois Univ., Urbana. Engineering Experiment Station.
**RESEARCH STUDIES ON PROBLEMS RELATED TO ANTENNAS Quarterly Progress Report, 1 Dec. 1964–28 Feb. 1965**
Mar. 1965 60 p refs
(Contract AF 33(657)-10474)
(QPR-10; AD-613044)

Studies on fifteen different aspects of antenna problems are reported. These include: radiation from periodic structures; log-periodic cavity-backed slot antennas; log-periodic magnetic current antennas; log-periodic zigzag antennas; logarithmic spiral antennas; multi-arm logarithmic spiral antennas; integrated antenna amplifier; wave propagation along helical conductors; periodic structures for wideband applications use of LP zigzag over a ground plane as a space filter; radiation lens illuminated from a Goubau beam waveguide; radiation from circular waveguides; omnidirectional and steerable beam antenna development at millimeter wavelengths; millimeter antenna test instrumentation; and components for omnidirectional and steerable beam millimeter wave antennas. M.G.J.

**N65-36821#** Motorola, Inc., Scottsdale, Ariz. Military Electronics Div.
**TESTS OF GROUND RECEIVER LOCK WITH AN UNLOCKED TRANSPONDER VCO**
R. Burt 15 Mar. 1965 42 p
(RFS-12)

In tests conducted to determine whether the ground receiver tracking loop will lock when the transponder in noncoherent operation, two changes to the transponder were considered. These were (1) widening the predetection bandwidth, and (2) narrowing the tracking loop filter. The effects of higher loop gain required to maintain tracking capability to some configurations were also considered. Details on transponder configurations, test procedures, and equipment configurations are given. It was found that the ground receiver will not lock to the transponder when operating in the coherent mode with no up-link carrier. However by narrowing the transponder threshold loop bandwidth to 75 cps and widening the pre-loop bandwidth to 85 kc, the ground receiver will lock to the transponder carrier loop and will operate down to threshold. Results also indicate that at strong signal doubling the transponder loop bandwidth doubles the phase jitter; doubling the transponder predetection bandwidth decreases phase jitter. At weak signal, thermal noise predominates. M.G.J.

**N65-36861#** Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
**FURTHER STATISTICAL PROBLEMS OF TRACKING A TARGET FROM AN OBSERVATORY SATELLITE**
Sam C. Saunders Apr. 1965 49 p refs *Its* Math. Note No. 377 Revised
(DI-82-0390; AD-615514)

The statistical problems of estimation and confidence for the location, speed, and heading of a target following a linear course when tracked by radar from an observatory satellite was studied. The joint distribution of the estimates for target position is derived; the maximum likelihood estimate is obtained, and a proof that it is normally distributed is given. The important theorems and formulas relating to the present mathematical model and an earlier version are compared. Successive estimates of target position with respect to the satellite observations are independent in the previous model, while they are dependent in the present model. Special cases are presented in which the results can be expressed in a simpler form than the general results. L.S.

# 08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

**N65-35834*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
**DESIGN OF REAL TIME COMPUTERS UTILIZING COUNTING TECHNIQUES**
George J. Moshos Washington, NASA, Oct. 1965 53 p refs
(NASA-TN-D-3042) CFSTI: HC $3.00/MF $0.50 CSCL 09B

The design of a class of special purpose computing machines, which compute by counting, is systematically developed. The basis of the design philosophy is to limit the basic building elements to three fundamental units and to develop the method of synthesis such that these three building elements are represented as operational units. In particular, the three basic building elements are (1) the binary rate multiplier, which is a means of scaling down a pulse stream to some specified fraction, (2) the counter, and (3) the anticoincidence circuit, which is a means of separating pulses arriving at the counter simultaneously. The computational errors, that is, rounding-off and truncation errors, introduced into the machines when these elements are treated as operational units are identified. The method of synthesis is explicitly stated, and a wide variety of machines obtained directly from this synthesis are presented. Finally, a series of machines is presented for interpolation and extrapolation of a function, which is available only as empirical data. Author

**N65-35842*#** AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
**JPL ENTRY VEHICLE DESIGN COMPUTER PROGRAM USERS MANUAL**
20 Sep. 1965 563 p Prepared for JPL
(Contracts NAS7-100; JPL-951070)
(NASA-CR-67377; AVCO-TR-23; RAD-TR-65-23) CFSTI: HC $8.63/MF $2.75 CSCL 09B

This manual for use of engineers engaged in entry vehicle trade-off studies provides the necessary description of the approximations contained in the subject computer programs and of the input procedures so that the programs can be utilized with ease and confidence. The manual contains a description of each program, a section on usage which describes the input and output, a section indicating the equations programmed and a section describing the IBM programming technique used. A total of (10) programs are described covering Trajectories, Aerodynamic Coefficients, Moments of Inertia, Parachute Systems, Impact Attenuator Systems, Radiation Heating, Pressure and Heating Distributions at Angle of Attack, Heat Shield Weight and Structural Weight Calculations. Author

**N65-35917#** Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
**CYCLIC CODES (RESEARCH PROGRAM TO EXTEND THE THEORY OF WEIGHT DISTRIBUTION AND RELATED PROBLEMS FOR CYCLIC ERROR-CORRECTING CODES AND CONSTRUCTIVE CODING THEORY) Summary Scientific Report No. 4**
E. F. Assmus, H. F. Mattson, and R. Turyn 28 Apr. 1965 94 p refs
(Contract AF 19(604)-8516)
(S-1015-4; AFCRL-65-332; AD-618914)

This document reports on error-correcting codes and questions arising in the study of them. Lower weights in quadratic-residue codes were found in continuing the study using cyclotomic numbers. The proof that all but a finite number of cyclic codes are optimal has been greatly simplified, and by the application of a result available even in the 1964 Report. We formerly knew that if a cyclic (n,k) code over GF(q) is optimal, then $q \geq n-k+1$. We now know that if any linear code is optimal, then with obvious exceptions, which we did not note last year, $q-1 \geq \max(k, n-k)$. And we have a result on the number of fixed points, among the coordinate functions of a code-automorphism. A determination of the weight-distribution in optimal codes and a proof of the fact that, except for the obvious exceptions, optimal codes are never perfect. We also derive certain congruence relations relating the dimension of a perfect code and the number of elements in the ground field. It follows immediately from the simplest of these that here are only finitely many perfect linear codes (as the ground field varies) of a given block length. Author

**N65-35960*#** Northwestern Univ., Evanston, Ill.
**A SURFACE-FITTING PROGRAM FOR AREALLY-DISTRIBUTED DATA FROM THE EARTH SCIENCES AND REMOTE SENSING**
E. H. Timothy Whitten, William C. Krumbein, Irma Waye, and Walter A. Beckman, Jr. Washington, NASA, Nov. 1965 150 p refs
(Grant NGR-14-007-027)
(NASA-CR-318) CFSTI: HC $5.00/MF $1.00 CSCL 09B

A flexible new FORTRAN II program capable of using a variety of methods to optimize computation of trend surfaces up to degree eight, forms the basis of this paper. The mathematical method of deriving the polynomial trend surface equations is briefly described. A complete listing of the program is included together with detailed operating instructions. Data obtained from photographs of a small sample grid in the NASA Pisgah Crater Test Site, California are used to illustrate the use of the program. The value of the program for analyzing the geographical variability of any remote sensor or earth science data is described. Author

**N65-36014#** Office of Naval Research, Washington, D. C.
**AUTOMATION AND THE NAVY**
[1964] 187 p refs Proc. of the 8th Navy Sci. Symp. held at the U.S. Naval Postgraduate School, Monterey, Calif., 13–15 May 1964
(ONR-21, Vol. 1; AD-606681) CFSTI: $3.00

CONTENTS:

1. NUMERICAL CONTROL RELATED TO THIN FILM CIRCUIT FABRICATION G. R. Stutzman (Naval Avionics Facility) p 1–12 (See N65-36015 24-15)

2. PROJECTED EFFECTS OF AUTOMATION ON FUTURE NAVY PERSONNEL REQUIREMENTS I. E. Kaplan (Naval Personnel Res. Activity) p 13–23 refs

3. COMPUTERS—ANALOG, DIGITAL, OR HYBRID? H. K. Skramstad (NOL) p 24–29 refs (See N65-36016 24-08)

4. MODULAR COMPUTER EXPLORATORY DEVELOPMENT R. D. Coleman (Naval Ordnance Test Sta.) p 40–53 refs (See N65-36017 24-08)

5. COMPUTER APPLICATIONS IN ENVIRONMENTAL PREDICTION AT FLEET NUMERICAL WEATHER FACILITY G. J. Haltiner (Naval Postgraduate School) and P. M. Wolff (Fleet Numerical Weather Facility) p 54–75 (See N65-36018 24-08)

6. TACTICAL SIMULATION METHODS Mitchell L. Cotton (Naval Postgraduate School) p 76–85 refs

7. CODED—A PROGRAM LEADING TO ELECTRONIC DESIGN AUTOMATION B. D. Tague and J. A. Ottlinger (Naval Avionics Facility) p 86–96 (See N65-36019 24-08)

8. AUTOMATION IN THE ACQUISITION AND REDUCTION OF EXPERIMENTAL DATA AT NOL, WHITE OAK B. D. Gilbert (NOL) p 97–115 (See N65-36020 24-08)

9. MACHINE CLASSIFICATION OF ACOUSTIC SIGNALS C. N. Pryor (NOL) p 116–126 (See N65-36021 24-23)

10. A SENSING DEVICE FOR THE MEASUREMENT OF STEAM QUALITY M. Greenberg (Marine Engineering Lab.) p 127–149 refs (See N65-36022 24-14)

11. THE APPLICATION OF COMPUTERS TO SOME HYDRODYNAMIC PROBLEMS IN SHIP DESIGN F. H. Todd (David Taylor Model Basin) p 150–175 refs

**N65-36016** Naval Ordnance Lab., Corona, Calif.
**COMPUTERS—ANALOG, DIGITAL, OR HYBRID?**
Harold K. Skramstad *In* ONR Automation and the Navy [1964] p 24–39 refs (See N65-36014 24-08) CFSTI: $3.00

The characteristics, relationships between, and capabilities of the analog, digital, and hybrid computers are discussed. The contrasting representations of analog and digital variables are listed. Types of problems that can be solved by each computer are cited. In conclusion it is predicted that the analog computer will grow in capability and increase its areas of application, but its role relative to the digital computer will decrease. The digital computer will grow in capability, the ease of communication between the man and the machine will improve, and will be applied in an increasing number of areas. The hybrid computer will be developed as an integrated computer, and will show tremendous growth. C.T.C.

**N65-36017** Naval Ordnance Test Station, China Lake, Calif.
**MODULAR COMPUTER EXPLORATORY DEVELOPMENT**
R. D. Coleman *In* ONR Automation and the Navy [1964] p 40–53 refs (See N65-36014 24-08) CFSTI: $3.00

A modular computer concept and a modular computer built from the concept are discussed. In the concept, each major section of a computer is an independent, replaceable module. Small families of these basic building blocks form a design stockpile. New modular computers are tailored to requirements by selecting and assembling appropriate modules. The size, design, and functions are readily changed at any time by adding, subtracting, or replacing modules. The control module is built primarily from two megacycle logic, with eight megacycle logic where higher speed is needed. The random access buffer memory has 4096 words of 36 bits each. Access time for the memory is three microseconds, and cycle time is six microseconds. The data transfer rate is approximately 40 kc. The input and output modules consist of two IBM 7094's, two Pace TR-48's, and a flexowriter typewriter. C.T.C.

**N65-36018** Naval Postgraduate School, Monterey, Calif.
**COMPUTER APPLICATIONS IN ENVIRONMENTAL PREDICTION AT FLEET NUMERICAL WEATHER FACILITY**
G. J. Haltiner and P. M. Wolff *In* ONR Automation and the Navy [1964] p 54–75 (Prepared jointly with Fleet Numerical Weather Facility, Monterey, Calif. (See N65-36014 24-08) CFSTI: $3.00

A series of experiments are presented to systematically evaluate the effects of omitting various terms in prediction equation, with respect to both the accuracy of the forecast pressure field and the time required to complete a forecast. A schematic diagram outlining the general procedure as well as three particular models is given. Charts are included of initial geopotential fields, 24-hour predicted fields, and verification maps. Some of the statistics regarding the three methods are summarized in tabular form. C.T.C.

**N65-36019** Naval Avionics Facility, Indianapolis, Ind.
**CODED—A PROGRAM LEADING TO ELECTRONIC DESIGN AUTOMATION**
B. D. Tague and J. A. Ottlinger *In* ONR Automation and the Navy [1964] p 86–96 (See N65-36014 24-08) CFSTI: $3.00

Computer design of power, audio, and small signal transformers, and electric circuits is considered. An automation program is discussed in which the user is provided with computer programs which require a minimum of training and experience to use. Computer inputs and outputs are simple and in the technical language of the user. The programs are adaptable to small or medium size computers. C.T.C.

**N65-36020** Naval Ordnance Lab., White Oak, Md.
**AUTOMATION IN THE ACQUISITION AND REDUCTION OF EXPERIMENTAL DATA AT NOL, WHITE OAK**
B.D. Gilbert *In* ONR Automation and the Navy [1964] p 97–115 (See N65-36014 24-08) CFSTI: $3.00

Various types of automated data handling are described. Automatic punched card and tape systems, digital magnetic tape data recording systems, and general purpose data systems are discussed. Areas where their use is applicable, and their operational rates are listed. It is concluded that automated data handling is feasible even in small volume applications. C.T.C.

**N65-36061** Army Chemical Center, Edgewood, Md.
**LANGUAGE ANALYSIS BY COMPUTER**
John C. Atkinson *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 185–193 ref (See N65-36050 24-19)

Methods presented for language analysis using a computer employ a single character mode. In one study it is found that students who are affected by a drug write significantly longer statements than those who experience an imagined effect. A significant increase in word length is also found for those given drugs. Results are based on computer analyses of reactions of eight subjects who were given placebos and 12 subjects who were given one of three different drug treatments; there were no significant differences between the three treatments. M.W.R.

**N65-36097#** Joint Publications Research Service, Washington, D. C.
**STUDIES ON COMPUTERS AND MODELING THE RECOGNITION PROCESS**
27 Aug. 1965 31 p ref Transl., into ENGLISH of 2 articles from Nauka i Zhizn' (Moscow), no. 6, 1965 p 2–6, 17–25 (JPRS-31746; TT-65-3241) CFSTI: $2.00

CONTENTS:

1. THE EFFECT OF COMPUTERS ON MATHEMATICS V. Glushkov p 1–8 ref (See N65-36098 24-08)
2. MODELING THE RECOGNITION PROCESS M. Bongard p 9–28 (See N65-36099 24-08)

**N65-36098** Joint Publications Research Service, Washington, D. C.
**THE EFFECT OF COMPUTERS ON MATHEMATICS**
V. Glushkov *In its* Studies on Computers and Modeling the Recognition Process 27 Aug. 1965 p 1–8 ref (See N65-36097 24-08) CFSTI: $2.00

A historical review of the effect of computer technology on the growth of mathematics is presented. Covered are such areas as the use of algorithms, symbolic algebra, programming, and machine language. L.S.

**N65-36099** Joint Publications Research Service, Washington, D. C.
**MODELING THE RECOGNITION PROCESS**
M. Bongard *In its* Studies on Computers and Modeling the Recognition Process 27 Aug. 1965 p 9–28 (See N65-36097 24-08) CFSTI: $2.00

A discussion of the functioning, implications, and problems of the recognition process are presented. A schematic diagram of the perceptron, a recognition system used for recognizing geometrical configurations, is illustrated, and the principle of the system is described. The concept of recognition is discussed with respect to logic systems used for the joint functioning of a large number of elements, and classification problems. The significance of a good choice of examples utilized in the instructions to a system is emphasized. L.S.

**N65-36151#** RAND Corp., Santa Monica, Calif.
**DEVELOPMENT AND USAGE OF THE ROCKET TRAJECTORY PROGRAM**
Barry W. Boehm Aug. 1965 8 p ref
(P-3187; AD-619348)

Rocket, a digital Fortran computer program, simulates trajectories of aerospace vehicles, numerically integrates the set of differential equations of motion of the vehicle specified, calculates automatically such aspects as earth gravitational and rotational effects, traces the trajectory of the vehicle as a function of time, and provides detailed information on its performance during flight. The program can investigate a number of variations on a given trajectory on a single run, greatly simplifying the process of trajectory matching or of making parameter studies. These and other Rocket Program capabilities are discussed in more detail. Suggestions are made on developing similar large general purpose computer programs. R.N.A.

**N65-36159#** Pennsylvania State Univ., University Park. Ordnance Research Lab.
**SYNTHESIS OF INPUT EQUATIONS FOR ERROR-TOLERANT COUNTERS**
E. C. Longenecker 16 Aug. 1965 123 p refs
(Contract NOw-65-0123-d)
(TM-621-3481-02; AD-620237)

A computer-oriented procedure was developed to derive the sets of dual-input equations for error-tolerant counters. An error-tolerant counter is one in which, although one of the flip-flops in the counter might be in error, the other flip-flops will continue to sequence properly. The counters are composed

of J-K flip-flops interconnected by *and–or* logic with an external sequencing pulse. Instead of using any of the known methods of simplication of Boolean functions, the synthesis procedure involves the selection of terms which satisfy a concise set of distance and intersection properties. The equations are minimized either for the fewest number of *ands* and diodes, or for the fewest number of undetectable malfunctions, where an undetectable malfunction is an undetectable control level diode on an *and*. Author

**N65-36186#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**A SELF-ADJUSTING SYSTEM**
M. L. Bykhovskiy and M. I. Breydo 26 Mar. 1965 6 p Transl. into ENGLISH from Soviet Patent no. 156822 (Appl. no. 640791/25) 2 p
(FTD-TT-64-1285/1+2; AD-614022)

This self adjusting system of programed control for metal cutting of machine tools utilizes a four register magnetic drum as an operative memory unit. Algebraic summations of the calculated program are integrated with the measurements of the finished part by a statistical integrator. A block diagram of the proposed system is shown. G.G.

**N65-36204#** System Development Corp., Santa Monica, Calif.
**SEMIANNUAL TECHNICAL SUMMARY REPORT TO THE DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY FOR THE PERIOD 18 NOVEMBER 1964–17 MAY 1965**
C. Baum, ed. [1965] 35 p refs
(Contract ARPA SD-97)
(TM-687/004/00)

Computer programing techniques are being developed to provide capabilities for time sharing, for the use of large computer systems by nonprogramers, and for handling natural language. A number of hardware and software changes were incorporated into the Q-32 computer resulting in a more reliable, responsive, and easier to use system. The LUCID and general purpose display system are operating well enough for demonstration purposes. The program was expanded to include work that exploits the potentials of on-line usage. This included modifications of the JOVIAL language to include useful features of TINT, an on-line interpretive JOVIAL system. Experimentation was conducted with interactive compilers enabling the on-line programer to communicate error messages and to ask for system responses. In the time sharing operations, the number of users exceeded the system capability, requiring priorities and scheduling. A program was developed enabling computer operators to monitor the system's use. Work was begun on the LISP II language and compiler system. Studies were initiated to determine if large data base handling systems can profit from being formulated in a list structure language. R.N.A.

**N65-36259#** Army Electronics Labs., Fort Monmouth, N. J.
**BATTERY DISPLAY UNIT (FEASIBILITY MODEL)**
Seth L. Everett, Jr. and Robert A. Cicero Jun. 1965 42 p
(ECOM-2601; AD-620590)

This report deals with the design and fabrication of a laboratory constructed breadboard model Battery Display Unit (BDU). The BDU system design concept permits it to receive and display data at speeds approaching that of the logic decoding circuits. Information reception at rates well in excess of those required is easily obtainable. The operating principles of the electromagnetic indicators used in the BDU are described. These principles offer important operating advantages with respect to the BDU application. General BDU operation theory and detailed logic circuit design information are included in this report. Excellent test results were obtained when operating the BDU at the required 300 characters/second input data rate. Excellent results were also observed when operating the BDU at lower data rates. This report is concluded by comparing the operating characteristics of the BDU with that of the existing FADU model. Author

**N65-36372#** Birmingham Univ. (England). Dept. of Mechanical Engineering.
**DIGITAL FLUID POSITION ENCODERS, PAPER E2**
G. A. Parker [1965] 16 p refs Presented at 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965
CFSTI: HC $1.00/MF $0.50

Electronic digital techniques are widely used for increasing the accuracy and resolution of control systems. The pure fluid circuit counterpart, while being comparatively very slow in operation, is potentially capable of extending the usefulness of digital control systems due to the inherent characteristics of reliability and cheapness. An important part of positional digital control circuits is the position encoder, which provides digital feedback information from the physical motion. The paper discusses the two general types of encoder, incremental and coded pattern, particularly with regard to signal error generation by ambiguous code reading. Existing work on pure fluid encoding systems is described and practical work on two coded pattern encoders discs presented. It is concluded that, at present, a straight line signal receiver configuration operating with a natural binary code disc appears to be the most promising encoder for fluid circuit applications. Author

**N65-36399*#** Maryland Univ., College Park. Computer Science Center.
**PAPER TAPE CONVERSION PROCEDURES**
H. D. Wactlar Aug. 1965 22 p refs
(Grant NsG-398)
(NASA-CR-67509; TR-65-22) CFSTI: HC $1.00/MF $0.50
CSCL 09B

Programs have been implemented for the conversion of punched paper tape information to IBM 7090/94 compatible card image records on magnetic tape, punched cards and printed page. The data is input by an IBM 1011 Paper Tape Reader or an IBM 1012 Paper Tape Punch to an IBM 1401 processor which performs selective output operations according to user provided format control cards. Two types of program have been made available, one for constant length paper tape records and one for records of varying length. The former program generates execution time instructions resulting from the user specifications whereas the latter uses a fixed stored program, branching at option test points. Author

**N65-36457#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**OPTIMAL CONTROL, INEQUALITY STATE CONSTRAINTS, AND THE GENERALIZED NEWTON-RAPHSON ALGORITHM**
Robert Mc Gill Jul. 1965 13 p refs
(RE-218J)

The generalized Newton-Raphson algorithm was extended to problems characterized by inequality constraints on the state space. The solution of the constrained optimal control problem was reduced, by the introduction of an additional state variable, to the solution of a sequence of unconstrained problems. Each subproblem was then solved by

the generalized Newton-Raphson algorithm and under appropriate conditions the sequence of solutions converged to the solution of the constrained problem. A numerical example for modification of the classical brachistrone problem is presented. G.G.

**N65-36461#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**DIGITAL COMPUTER GENERATED STEREOSCOPIC POINTILLE (MARKED BY DOTS) SURFACES. PART I: THEORY AND RESULTS. PART II: PROGRAMS**
G. R. Stoodley and J. S. Miller Apr. 1965 88 p refs
(RM-275)

The theory and results of a study to generate by digital computer stereoscopic pointille surfaces are presented. The mathematical formulation for distributing points on a given surface is discussed. The methods for defining surfaces and locating points on these surfaces are outlined. The mathematical points are translated into a stereoscopic pair by a perspective program using an off-line digital incremental plotter. The stereo effect is achieved by viewing two perspective drawings obtained from different viewing positions. Several stereo drawings are given as examples. For complicated surfaces not exhibiting any overlap, the points present a vivid display of the surface. Placing the points uniformily on a surface eliminates the need for generating different sets of points for different orientations. Two computer programs written in Fortran II for implementing the techniques are described in detail. One program, MIT random points, uses four user-supplied boundary curves to define the surface that is then represented by dots. The other, grid random points, generates a surface from a grid of points. R.N.A.

**N65-36479#** Christian Michelsens Institutt for Videnskap OG Andsfrihet, Bergen (Norway).
**AUTOMATIC PARAMETER SEARCH ON AN ANALOG COMPUTER Anita Report No. 14**
Karl M. Wiig 25 Apr. 1964 20 p refs
(Contract AT(30-1)-2607)
(TID-21546) CFSTI: HC $1.00/MF $0.50

Parameter search—the problem of finding the values of parameters so as to fit a mathematical model to experimental data by means of recurrent solutions of the mathematical model with different parameter values—is an optimizing problem with a discrete strategy, where the performance criterion is a mathematical evaluation of the goodness of fit. The identification and instrumentation of such a strategy are discussed, including performance evaluation, control signal generator, and executive logic, and the strategy is applied to an actual parameter search problem. NSA

**N65-36513#** Battelle-Northwest, Richland, Wash.
**LISTIV: A FORTRAN IV GENERALIZED INPUT ROUTINE**
D. D. Matsumoto Mar. 1965 11 p
(Contract AT(45-1)-1830)
(BNWL-41)

The subroutine generalized Fortran input Listin is incompatible with Fortran IV. The subroutine Listiv was therefore written to make Listin-type input possible with Fortran II codes being converted to Fortran IV without extensive revision and for new applications in which programming time can be cut and data preparation simplified because of the familiarity of the input format of Listin. The Listin concept, description of input cards, system options, programming for Listiv, and differences between Listin and Listiv are discussed. Also sample code and sample output are included. E.E.B.

**N65-36528#** Gt. Brit. National Inst. for Research in Nuclear Science, Chilton. Theoretical Studies Group.
**THE DESIGN OF THE ORION FORTRAN MONITOR SYSTEM**
J. W. Gardner and D. A. Harragan Aug. 1964 39 p
(NIRL/R/73)

This report describes the structure of the Fortran monitor system (Formap). Formap controls and directs the processing of programs written in Fortran. This processing consists of compiling, editing and assembling routines into complete object programs ready for execution. Formap contains two compilers, Forcom and Facom, but this report only covers in detail the monitoring, editing and assembling portions, giving the specifications of the computer languages used. The operation and facilities of Formap are dealt with in "A User's Guide to the Orion Fortran Monitor System", which has been issued as a separate publication. Author

**N65-36737#** Applied Logic Corp., Princeton, N. J.
**SEMI-AUTOMATED MATHEMATICS: SAM IV Scientific Report No. 3**
James H. Bennett, William B. Easton, James R. Guard, David B. Loveman, and Thomas H. Mott, Jr. 15 Oct. 1964 96 p refs
(Contract AF 19(628)-3250)
(AFCRL-64-827; AD-619301)

The fourth in a series of computer experiments on theorem proving is described. The man–machine interactive program is designed to handle any mathematical statement that can be expressed by means of many sorted variables and constants for an $\omega$-order predicate-function calculus with equality, lambda, and methods of definition. Natural deduction by subordinate proof is used to carry out proofs. The program includes a convenient input/output language, a language for handling sorts and range of symbols, and an automatic logic routine whose function is to automatically justify proof lines which "trivially" follow from previous results. Author (TAB)

**N65-36784#** Illinois Univ., Urbana. Coordinated Science Lab.
**SELF-DIAGNOSIS OF ELECTRONIC COMPUTERS: AN EXPERIMENTAL STUDY**
Eric G. Manning Jul. 1965 80 p
(Grant NSF GK-36)
(R-259; AD-620248)

The problem considered is the development of design principles which will permit the design of self-diagnosing computers. A self-diagnosing computer is one for which there exists a self-diagnosis procedure, defined as an experiment having one of two outcomes: (1) all transistor-diode logic is entirely failure-free; or (2) card or module x has a failure of type y. Also, the procedure must be sufficiently fast to permit execution every few hours, using non-technical personnel. [Existing diagnostic programs are self-diagnosis procedures, but they suffer from two disadvantages. A successful run of a diagnostic program is no guarantee that the computer is in fact free of malfunctions; and the results of an unsuccessful run are generally of little help in locating a failure.] Consequently, an attempt was made to derive a self-diagnosis procedure for the execution-phase hardware (main control, arithmetic unit, and decoders) of an existing machine (the CSX-1). The principal experimental tool was the Sequential Analyzer system. Author (TAB)

**N65-36801#** Joint Publications Research Service, Washington, D. C.
**SOME PROBLEMS IN AUTOMATING THE COLLECTION AND PROCESSING OF INFORMATION USING ELECTRONIC COMPUTERS**
Ye. Borisenkov 7 Oct. 1965 10 p Transl. into ENGLISH from Morsk. Flot (Moscow), no. 7, Jul. 1965 p 16–18
(JPRS-32299; TT-65-32789) CFSTI: $1.00

A brief summary is given of the introduction of electronic computers into the field of meteorology. Various phases of meteorological information processing are discussed, including the introduction of information directly into the computer via communications lines and its encoding; preliminary checking of the data for finding and correcting gross errors; processing the information according to the given program; and output of the processing results from the electronic computer.
G.A.L.

**N65-36856#** National Oceanographic Data Center, Washington, D. C. Data Processing Div.
**COMPUTER PROGRAMS IN OCEANOGRAPHY (PROVISIONAL) Catalog Series**
1964 34 p
(C-5; AD-613598)

This report consolidates the Computer Programs in Oceanography Preliminary List (NODC Progress Report P-12) of June 1963 and the Supplementary List issued September 1963. Revisions and corrections have been made, and a considerable amount of additional material has been included. The listings are arranged, as in previous compilations, alphabetically by agencies and institutions and are grouped by computer make and model. Abstracts of the computer programs have been revised to contain the estimated running time and, under "program Description" the error introduced by mathematical techniques used in computation.
TAB

**N65-36862** Illinois Univ., Urbana. Coll. of Engineering.
**LINEAR NETWORK ANALYSIS AND REALIZATION DIGITAL COMPUTER PROGRAMS: AN INSTRUCTION MANUAL**
D. A. Calahan [1965] 26 p refs *Its* Eng. Expt. Sta. Bull. No. 472
(Grant AF-AFOSR-177-63)
(TSL-121-2-65; AD-615099)

Digital computer Fortran programs for the analysis and realization of linear electrical networks are described, and ten examples of their use are given. For input data, the analysis program requires a list of elements, the input and output numbers, and the type of desired network function. The program then calculates the coefficients of the required network function, the poles and zeros, frequency response, and transient response to an arbitrary input. Allowed elements types are resistors, capacitors, inductors, nonideal transformers, and voltage-controlled current sources in arbitrary configuration. Network size is limited to 12 to 15 nodes, and 25 to 30 elements. For input data, the realization program requires an existing design which is nearly close to its final form. The element values are perturbed until the final design is achieved. The final design is specified by prescribing element values and/or a network function T(S). It was assumed that the approximation problem was solved and that the coefficients of the desired T(S) are known.
R.W.H.

# 09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

**N65-35804#** United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
**ELECTRON BEAM TECHNIQUES FOR FABRICATION AND ASSEMBLY OF PARTS FOR ELECTRON TUBES Sixth Quarterly Report, 1 Oct.–31 Dec. 1964**
J. F. Dudenhoefer [1964] 30 p refs
(Contract DA-36-039-AMC-03625(E))
(EBR-159; AD-617007)

The program objectives and a concise summary of the program history are presented. Program progress for this reporting period is delineated and includes: evaluation and acceptance of the 6544 preproduction tubes and a discussion of the problems encountered in fabricating the 6914A preproduction tubes. Proposed objectives for the seventh reporting period are outlined.
Author

**N65-35843*#** ITT Industrial Labs., Fort Wayne, Ind.
**RESEARCH IN THE DEVELOPMENT EFFORT OF AN IMPROVED MULTIPLIER PHOTOTUBE Final Report**
F. Barr and E. Eberhardt 30 Aug. 1965 82 p refs
(Contract NASw-1038)
(NASA-CR-67378) CFSTI: HC $3.00/MF $0.75 CSCL 09A

A number of important factors determining single electron counting properties of multiplier phototubes were investigated. Discussed are the effects of primary electron energy on the pulse height distribution; dynode secondary emission ratio enhancement; low energy electron control; first dynode gain mapping, and the windowless multiplier pulse height distribution. A noise source investigation of pulse counting circuits was also conducted, and cooling tests were run on the phototubes. Graphs and diagrams in support of the study are included. Several promising specific design procedures for improving the counting properties of the tube were found. The investigation confirmed that achievement of improved single electron counting properties (e.g. Poisson or quasi-Poissonian pulse height distribution) can be expected in multiplier phototubes if close attention is paid to known basic principles of electron behavior.
L.S.

**N65-35913#** Texas Instruments Inc., Dallas.
**PRODUCTION ENGINEERING MEASURES (PEM) FOR MICROELECTRONIC CIRCUITRY AND MILLIWATT LOGIC SEMICONDUCTOR INTEGRATED CIRCUITS Quarterly Progress Report No. 3, 1 Jan.–31 Mar. 1965**
[1965] 54 p
(Contract DA-36-039-AMC-03637(E))
(TI-03-65-46; AD-618934)

Devices showing considerable improvement in diode leakage were produced during the third quarter. Increased temperature stabilization of the material brought the diode leakages down to less than 10 uuamp for the standard gate and power gate. Additional gold doping decreased the propagation delay ($t_{pd}$) on the standard gate from 25 nsec to 12 nsec at 125° C. Delay elements which met specifications were also shipped. Additional gold doping will be incorporated to decrease storage time.

Activities in the material preparation area centered around evaluation of the "common carrier". Improvements were made in several operations in the bar preparation and assembly areas and improvement programs were begun in the functional probe and bar mount operation. The automatic switching time test station was completed and turned over to manufacturing. Author

**N65-35923#** Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
**CYCLOTRON WAVE DEVICES STUDY Quarterly Progress Report, 1 Jan.–31 Mar. 1965**
T. Kao, D. C. Watson, C. H. Durney, C. C. Johnson, and R. W. Grow [1965] 16 p refs
(Contract DA-36-039-AMC-02372(E))
(Rept.-7; AD-618735)

The reassembled cyclotron-synchronous wave amplifier was tested with little improvement. The experimental results indicate that further tests should be conducted with an optimum $\rho/\rho_{br}$ ratio at higher power levels. The cyclotron-wave power converter has been operated to the three-watt level, and saturation results were observed which agree closely with theoretical predictions. The a-c characteristics of the device have been examined. Present conversion efficiencies are somewhat lower than first reported. Author

**N65-35943#** Data Corp., Dayton, Ohio.
**HIGH RESOLUTION CATHODE RAY TUBE EVALUATION Final Engineering Report**
Wright-Patterson AFB, Ohio, ASD, Apr. 1964 104 p
(Contract AF 33(616)-4206)
(ASD-TDR-63-796; AD-600517)

An outline and a means of comparing four basic methods of cathode ray tube testing used in industry are presented. An analysis of each test method, its restrictions, limitations, and advantages are discussed along with the basic requirements for testing cathode ray tubes. The four methods, selected as possible test standards, include the shrinking raster test method, the aperture response method, the single line method, and the double line method. Five resolution cathode ray tubes were subjected to the four test methods and the results are indicated for comparison. The appendix gives a detailed description of the cathode ray tube analyzer designed for performing the various tests described. R.N.A.

**N65-35969*#** General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
**DEVELOPMENT OF ELECTRIC SWITCHGEAR FOR SPACE NUCLEAR ELECTRICAL SYSTEMS Quarterly Progress Report No. 3, Jun. 4–Sep. 4, 1965**
A. H. Powell, ed. [1965] 48 p
(Contract NAS3-6467)
(NASA-CR-54743) CFSTI: HC $2.00/MF $0.50 CSCL 09A

Continued research conducted under a program designed to provide data from which final flight hardware for planned nuclear space power systems of 1- to 4-Mw capacity could be developed, is reported. Development effort will result in building and testing ground prototype breakers (600-amp and 1000-V) and contractors (10 000 volts-dc) which can withstand launch environment (mechanical) conditions, as well as expected space conditions including low pressure, high temperature, and radiation. The devices are also able to successfully interrupt short circuits of twice normal current ratings. All details for making the sample breakers and contactors were completed, most of the required raw material was obtained, and plans for fabrication and assembly were initiated. Parts of both the vacuum interrupters and the actuators were investigated. Proposed construction and assembly methods were checked, and improved latch and trip mechanisms were created and included in the final design. Designs were frozen and all detail and assembly drawings issued. A sketch of the complete breaker is included. Raw material is being reviewed to determine the most favorable processor. Test specifications are being prepared, and the assemblage of high vacuum oven equipment for the first tests (heat run) initiated. Data on expected milestone dates was also compiled. S.C.W.

**N65-35995#** Westinghouse Electric Corp., Elkridge, Md. Molecular Electronics Div.
**IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY OF SILICON PLANAR EPITAXIAL DEVICES Final Report, 1 Jul. 1963–9 Apr. 1965**
A. T. Hamill [1965] 493 p
(Contract DA-36-039-AMC-03617(E))
(AD-614604)

The production engineering measure for improving production techniques to increase the reliability of microelectronics monolithic circuitry and the silicon planar epitaxial transistor WX 4001 was satisfactorily completed. Production techniques in the areas of diffusion, photochemistry, assembly, encapsulation, and design were improved. The most significant improvement in reliability came from eliminating pinholes in the passivating oxide layer. Temperature was found to be the stress most useful in accelerating failures for reliability analysis and prediction. Temperature combined with electric field provides insight into device behavior. Extensive failure analysis was performed and several useful failure analysis techniques were evolved. The improved devices exhibited a high order of stability in the storage and operating life tests at temperatures up to 225° C. Extrapolation of the temperature analysis of the drift of output cutoff current of the WM 201Q at 125° and 25° C enabled a prediction of a failure rate of less than .01% per 1000 hours at 25° C for the logic blocks. R.N.A.

**N65-36190#** Rome Air Development Center, Griffiss AFB, N. Y. Communications Research Branch.
**LOW TEMPERATURE RESISTANCE OF SELECTED RESISTORS**
Mark W. Levi Aug. 1965 18 p
(RADC-TR-65-294; AD-620502)

Selected resistors have been measured over the liquid helium and liquid nitrogen ranges of temperature. The best resistors had only a 2 percent total variation of resistance. Author

**N65-36197#** Hughes Aircraft Co., Oceanside, Calif. Vacuum Tube Products Div.
**RESEARCH AND DEVELOPMENT OF TWO-COLOR DIRECT VIEW STORAGE TUBE WITH SELECTIVE ERASURE Interim Development Report, 1 Oct. 1963–1 Jan. 1964**
P. P. Damon Jan. 1964 19 p refs
(Contract NObsr-89452)
(AD-432055)

A direct view storage tube is being developed which is capable of displaying stored information in either of two colors or in intermediate hues, and selectively erasing that information. The operating principle is based on the fact that flood electrons which pass through holes in the storage mask when the storage surface potential is near cutoff, fall within small areas on the viewing screen opposite the storage mask holes; whereas flood electrons which pass through the holes when

the potential is near its maximum, (i.e., flood gun cathode potential), fall on larger overlapping areas of the viewing screen. The viewing screen consists of two phosphors. One occupies small areas in register with the storage-mask holes, while the other occupies areas surrounding the first. This tube is 10 inches in diameter and is based on work performed under a previous contract. It differs from the tube developed under that contract in that a selective erase feature has been added and an axial flood gun is utilized. The additional selective erase gun permits viewing of the stored information at the written chromaticity until just prior to introduction of new information. Included in this report are spot spread and target control characteristic data measured on a monochromatic tube using a refined storage mesh to confirm the initial design. Author

**N65-36198#** Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
**HIGH-PRECISION PRESSURE SENSOR Thirteenth Quarterly Progress Report, 8 Nov. 1963–7 Feb. 1964**
Lewis G. Anderson, William H. Crabtree, Theodore J. Cruise, and Edward J. Mc Kay, Jr. Feb. 1964 40 p refs
(Contract NOw-61-0400)
(ESL-QR-194; AD-432882)

This report summarizes progress made toward the development of a zero to 2500 psi pressure sensor having an overall precision of 1/4 psi. Present emphasis is on developing a practical instrument based on a velocity of sound technique whose feasibility was demonstrated earlier. Newly designed echo selector and detector–transmit coupling circuitry is described, and test results presented. Results of an experimental study of the effect of several sound path design parameters on the achievable transit time are described. A detailed summary of the current status of the project, and plans for continuation are presented. Author

**N65-36203#** Illinois Univ., Urbana. Digital Computer Lab.
**A NOVEL FAMILY OF DIGITAL CIRCUITS**
Donnell Michael Collins, Jr. (M.S. Thesis) 22 Sep. 1964 87 p refs *Its* Rept.-169
(Contract AT(11-1)-1018)
(COO-415-1028)

Logic elements were described which offer a novel solution to the problem of compatibility of input and output levels. The basic design of an inverting NOR/NAND element was developed, with a restoring OR/AND variant, available with minor component rearrangement. The existence was shown of workable circuits using identical components in either of the two available configurations. The OR/AND circuit was shown to be suited to the economic production of the composite logic functions required by storage and pulse forming elements.
R.W.H.

**N65-36227#** General Electric Co., Syracuse, N. Y. Tube Dept.
**RESEARCH AND DEVELOPMENT OF MINIATURE, ENVIRONMENTALIZED, ELECTROSTATIC IMAGE ORTHICON Final Report, 1 Sep. 1963–31 Jan. 1965**
B. E. Day [1965] 63 p ref
(Contract DA-36-039-AMC-02264(E))
(Rept.-14; AD-620547)

The development of an electrostatic image orthicon, which has been miniaturized and ruggedized, is described. Resolution sensitivity curves as well as other performance characteristics are included, and center-to-edge resolution improvement in the electrostatic image-section are discussed. Author

**N65-36237#** North Electric Co., Galion, Ohio.
**STUDY OF AUTOMATIC ROUTING IN A SWITCHED SYSTEM UTILIZING SATURATION SIGNALING Second Quarterly Report, 1 Oct.–31 Dec. 1964**
L. Robinson, H. Rondina, R. Sweet, R. Starr, and S. Sternung [1964] 57 p refs
(Contract DA-28-043-AMC-00342(E))
(Rept.-2; AD-620686)

Work consisted of a detailed study of priority implementation in both saturation signaling and direct routing procedures. Also, reported are the same two priority methods as programed in the saturation signaling and direct routing simulators. A consideration of character identification codes led to definition of a method for PBX call addressing and a breakdown of internode processing time. The characteristics of a revised message generator program are discussed. An analytical method is elaborated to combine voice and data traffic loads (different holding times) on a link for determining how many trunks the link should have for a given link grade of service. Author

**N65-36240#** Harry Diamond Labs., Washington, D. C.
**AN ELECTRONIC DESIGN FOR A GENERATING ELECTRIC FIELD–ION CURRENT METER**
Gordon D. North 14 Jul. 1965 29 p
(HDL-TM-65-36; AD-620171)

Problem areas encountered in operating a generating type electric field meter of earlier design, and a new electronic system developed to overcome these problems are described. The instrument was to measure the electrostatic charge history of a ballistic missile during its flight but ambiguous results were obtained because of the meter's inability to distinguish between signals due to electrostatic charge and those due to an electric current flow to the probe. The instrument consists of a conducting probe that is alternately exposed to and shielded from an electric field by a motor driven grounded rotor. The charge induced on the probe develops a voltage proportional to the electric field. The original meter used a linear response amplifier that had a limited dynamic range and included no method for separating signals due to collection of ion current from those due to electric field. In the redesign, a dual channel synchronous demodulator amplifier is used to separate electric field and photoemissive and ion current signals. The field channel uses a logarithmic amplifier that handles 100 to 100 000 volts per minute. Based on limited test data, the new system is considered suitable. R.N.A.

**N65-36257#** Army Electronics Labs., Fort Monmouth, N. J.
**EVALUATION OF A LOW-DRAIN NUVISTOR OSCILLATOR-AMPLIFIER TRIODE**
W. G. Muessle Jun. 1965 30 p
(ECOM-2604; AD-620330)

The A-15496 nuvistor triode was evaluated to determine its capabilities for military application. Data are presented for static characteristics, voltage gain, noise figure, input admittance, cross modulation, and rf power output. Author

**N65-36275#** Radio Corp. of America, Camden, N. J. Communications Systems Div.
**MICROELEMENT TRANSISTORS: MICROMODULE PROGRAM EXTENSION II Formal Engineering Report**
Feb. 1965 266 p
(Contract DA-36-039-SC-75968)
(AD-614624)

CONTENTS:

1. ABSTRACT 3 p
2. CONCLUSIONS AND RECOMMENDATIONS 23 p
3. PROCESS ANALYSIS PHASE 13 p
4. VHF GERMANIUM PNP MESA TRANSISTOR MICROELEMENT Final Report 40 p (See N65-36276 24-09)
5. SILICON ALLOY JUNCTION TRANSISTOR MICROELEMENT Final Report 26 p (See N65-36277 24-09)
6. ELECTROCHEMICALLY ETCHED TRANSISTOR MICROELEMENT Final Report 41 p (See N65-36278 24-09)
7. SILICON POWER TRANSISTOR MICROELEMENT Final Report 21 p (See N65-36279 24-09)
8. EQUIVALENCE OF SELECTED TRANSISTORS TO GROWN-JUNCTION 2N335 TRANSISTOR Final Report 30 p (See N65-36280 24-09)
9. NPN SILICON GROWN JUNCTION 2N335 TRANSISTOR MICROELEMENT Final Report 49 p (See N65-36281 24-09)
10. ULTRASONIC CLEANING Final Report 9 p (See N65-36282 24-09)

**N65-36276** Texas Instruments, Inc., Dallas. Semiconductor-Components Div.

**VHF GERMANIUM PNP MESA TRANSISTOR MICROELEMENT Final Report**

*In* RCA Microelement Transistors Feb. 1965 40 p (See N65-36275 24-09)

The major area of engineering activity concerned was to design and evaluate a package that would meet or exceed the program requirements. The micromesa package design was completed. Initial problems encountered were due to weld and flange leaks. The material flange was changed from krovar to nickel, improving the concentricity between the ceramic and the metal. The silver-copper braze material exhibited intergranular corrosion between the krovar leads and the silver containing alloy. This was corrected by changing the braze material to copper–gold, and the lead material to nickel. The nickel leads gave added flexibility, while reducing mechanical failures. The gold–copper braze alloy eliminated intergranular corrosion. Capability was established to fabricate a specific type of device meeting all electrical and environmental requirements. The improved design of welding electrodes used on the assembly process yielded a significant improvement on the veeco leak failure rate. It was concluded that conventional germanium and silicon devices can be repackaged in a TO-50 micromesa package compatible with the micromodule program. Micromodule transistors having the required degree of reliability can be built equal to existing device types in other packages. R.W.H.

**N65-36277** Sperry Rand Corp., Norwalk, Conn. Sperry Semiconductor Div.

**SILICON ALLOY JUNCTION TRANSISTOR MICROELEMENT Final Report**

*In* RCA Microelement Transistors Feb. 1965 26 p (See N65-36275 24-09)

Establishing a qualified source for a silicon alloy junction transistor family that met the dimensional and environmental requirements of micromodules is considered. Areas completed are: 100 units for evaluation of package hermeticity and module processing compatibility; 200 units for evaluation of the devices ability to meet all of the requirements of microelement transistors; and 300 units as a pre-production run made with the production facilities developed. R.W.H.

**N65-36278** Philco Corp., Lansdale, Pa.

**ELECTROCHEMICALLY ETCHED TRANSISTOR MICROELEMENT Final Report**

*In* RCA Microelement Transistors Feb. 1965 41 p (See N65-36275 24-09)

A total of 100 microelement transistors were fabricated and delivered. These units satisfied the technical objectives of demonstrating hermeticity and module processing compatibility, and were accepted for completion. In another phase 250 microelement transistors were fabricated, tested, and delivered. The two types used were proven, high-production types, permitting the major emphasis to be directed at meeting the specified maximum over-all height of 0.090 inches. Various steps were taken in the effort to meet this specification. A slight modification was made in the active device structure to allow a decrease in height of the TO-46 outline package selected. Wafers were obtained with a recessed area for transistor package mounting. The feasibility of fabricating the germanium and silicon transistor in microelement form for the micro-module program were demonstrated. R.W.H.

**N65-36279** Radio Corp. of America, Somerville, N. J. Electronic Components and Devices Div.

**SILICON POWER TRANSISTOR MICROELEMENT Final Report**

*In* RCA, Camden, N. J. Microelement Transistors Feb. 1965 21 p (See N65-36275 24-09)

This report presents the results of the work performed under the preproduction phase of Contract DA-36-039-SC-75988. During the course of this program, 400 transistors were mounted in the TO-46 Microbloc case and aged for 1000 hours at 175° C. Two hundred of the units were then mounted on ceramic wafers to form the microelements. After mounting onto the ceramic wafers, the units were subjected to the various tests as called for in the specification. The results of these tests, along with conclusions drawn and recommendations for future action, are also presented. Author

**N65-36280** Radio Corp. of America, Somerville, N. J. Electronic Components and Devices Div.

**EQUIVALENCE OF SELECTED TRANSISTORS TO GROWN-JUNCTION 2N335 TRANSISTOR Final Report**

*In* RCA, Camden, N. J. Microelement Transistors Feb. 1965 30 p (See N65-36275 24-09)

A program to verify the equivalence of newer type transistors to the grown-junction transistor was started. The Raytheon allow-type transistor demonstrates equivalence to the grown-junction transistor for all parameters studied. This device is supplied in a package which was mounted onto a micromodular wafer. For applications where an over-all microelement height of 180 mils was tolerated, this alloy-type transistor was recommended as a direct replacement for the grown-junction device. It was shown the Rheem mesa and the Fairchild planar transistors outperform the grown-junction transistor in several parameter areas, exhibiting extremely low leakage currents, high breakdown voltages, very low saturation voltages, and useful current gains at low levels of collector current. R.W.H.

**N65-36281** General Electric Co., Syracuse, N. Y. Semiconductor Products Dept.

**NPN SILICON GROWN JUNCTION 2N335 TRANSISTOR MICROELEMENT Final Report**

*In* RCA Microelement Transistors Feb. 1965 49 p (See N65-36275 24-09)

The inclusion of the grown diffused junction transistor into a microelement package was successfully demonstrated. The package height requirement of 0.090 inch maximum was met

by the use of a TO-46 microblock header, hermetically sealed, and mounted on a microelement wafer. Internally, the device retains all of the features of its TO-5 counterpart, including the fixed bed ceramic disc mounting to ensure mechanical ruggedness. Units were subjected to environmental and mechanical tests consisting of temperature cycling, moisture resistance, shock, vibration fatigue, and variable vibration. In addition, 1000-hour life tests, consisting of 200° C storage and operating life were performed. R.W.H.

**N65-36282** Radio Corp. of America, Somerville, N. J. Electronic Components and Devices Div.
**ULTRASONIC CLEANING Final Report**
*In* RCA, Camden, N. J. Microelement Transistors Feb. 1965 9 p (See N65-36275 24-09)

Representative semiconductor devices selected from families of transistors and diodes having application in micromodules were subjected to ultrasonic agitation of the micromodule cleaning process. Of the four representative transistor types and one representative diode type subjected to ultrasonics, all but one transistor type demonstrated complete compatibility. Author

**N65-36298#** City Coll. of the City of New York. City Coll. Research Foundation.
**ELECTROSTATIC FOCUSING OF HOLLOW SPIRALING ELECTRON BEAMS Second Quarterly Report, 5 Apr.–5 Jul. 1965**
Morris Ettenberg [1965] 66 p
(Contract DA-28-043-AMC-00466(E))
(Rept.-2; AD-620601)

Two experiments were performed during this quarter. The first experiment failed before significant operation was achieved. The cause of the failure was a broken filament. Enough experience was gained with this model to indicate the desirability of a change in design. The second, redesigned experimental model has been operated and performance data have been taken. The best transmission has been about 20%. MAD programs have been written for the solution of Laplace's Equation in cylindrical coordinates and for the calculation of electron trajectories in electrostatic fields neglecting space charge. Various injection conditions have been calculated. Author

**N65-36320#** Union Carbide Corp., Cleveland, Ohio. Linde Div.
**PRODUCTION ENGINEERING MEASURE FOR IMPROVED RELIABILITY OF SOLID TANTALUM ELECTROLYTIC CAPACITORS Final Report, 1 Jul. 1963–30 Jun. 1965**
H. W. Holland [1965] 106 p
(Contract DA-36-039-AMC-03624(E))
(AD-620599)

A review of progress in process refinement is followed by descriptions of the processes studied and a manual for control of quality from raw material through finished product. The first step in the engineering studies was establishment of life test "acceleration factors". The acceleration factors provide a relationship between the applied voltage and the equivalent time on test, with a higher-than-rated voltage producing the same effect as a longer time at rated voltage. Compared to normal life testing, this work produced a significant reduction in the time required to evaluate the effect of a process change on the failure rate of capacitors affected. Author

**N65-36392*#** Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
**COMPUTER-AIDED ELECTRONIC CIRCUIT DESIGN, PART I. CONDUCTION PROCESSES IN THIN FILMS, PART II Status Report, 1 Dec. 1964–31 May 1965**
Jun. 1965 43 p refs
(Grant NsG-496)
(NASA-CR-67494; ESL-SR-245) CFSTI: HC $2.00/MF $0.50
CSCL 09A

A computer program makes it possible to analyze electrical networks consisting of linear and nonlinear resistors, inductors, and capacitors excited by voltage and current sources which may be arbitrary functions of time. Circuit configurations and analytical results are displayed on a cathode-ray-tube output of a time-shared computer. Also presented is a summary of work under way in logic design and synthesis through use of a digital computer. A low-cost teletype-operated graphical display is described as well as a new approach to nonlinear circuit analysis through use of a computer. Part II relates to conduction processes in thin films. This work is motivated by a desire to understand better mechanisms by which conduction takes place in thin semi-insulating films and between sandwich layers of these films. Cadmium sulfide is used as a vehicle for the investigations. Author

**N65-36401#** Research Inst. of National Defence, Stockholm (Sweden). Dept. of Physics.
**CONTROL OF A BOUNDARY LAYER FLUIDISTOR BY MEANS OF DISRUPTIVE DISCHARGE, PAPER B4**
K. Sture Nyström and Gunnar Brodin [1965] 8 p Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

A method for directly acting electrical control of a flip-flop fluidistor (pure fluid device) is presented. The electrical control signal triggers a high voltage pulse generator connected to electrodes in the fluidistor mixing region. Disruptive discharges between the electrodes produces pneumatic pressure shocks, the fluidistor output flow being switched by these shocks. Author

**N65-36451#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**THE USE OF SUPERCONDUCTORS FOR GENERATION OF HIGH MAGNETIC FIELDS, PART II: THE DESIGN, CONSTRUCTION AND OPERATION OF A 50000-GAUSS SUPERCONDUCTING SOLENOID**
Samuel D. Lindenbaum Jan. 1965 32 p refs
(RE-200)

This report, dealing with the use of superconductors for the generation of high magnetic fields, presents a description of the construction and operation of a 50000-gauss Nb-Zr superconducting solenoid. Particular emphasis is laid upon the relevant design features and the winding techniques employed. A brief discussion of coil protection devices is presented along with formulae for the calculation of solenoidal fields, solenoid inductance, stored energy, and the mechanical stresses which arise in the magnet windings. Author

**N65-36498#** California Univ., Berkeley. Lawrence Radiation Lab.
**A GUIDE FOR DESIGNING ELECTRICAL CONTROLS OF ACCELERATORS**
C. A. Harris 24 Mar. 1965 62 p
(Contract W-7405-ENG-48)
(UCRL-16016) CFSTI: $3.00

This report describes a general but unified set of procedures to be followed by engineers who are designing accelerator controls. It serves not only as a designer's guide but also as a supplement to local and national sets of mechanical and safety codes that may be applicable to any given accelerator, and includes also areas not specifically covered in the safety codes. Author

N65-36562*# Space Technology Labs., Inc., Redondo Beach, Calif.
**X-BAND SOLID STATE SIGNAL SOURCE Special Report**
C. B. Coulbourn 15 Jan. 1965 70 p
(Contract NAS8-5205)
(NASA-CR-67567; STL-8411-6003-RU-000) CFSTI: HC $3.00/MF $0.75 CSCL 09E

A feasibility study was made of a 1 watt X-band solid state signal source. Achievements reported include: the development of hardware which has the advanced characteristics necessary for a flight packaged, flight proofed high power solid state signal source; the successful adding of the output powers from three separate amplifiers; and the development of frequency doublers operating from the L- through X-band which permit operation at twice the power levels of corresponding single ended multipliers, and appear to provide much less tuning sensitivity. G.A.L.

N65-36578# New Hampshire Univ., Durham. Dept. of Electrical Engineering.
**SYNTHESIS OF DRIVING-POINT IMPEDANCES BY RC GYRATOR NETWORKS**
James Carmen Jalbert (M.S. Thesis) Feb. 1965 83 p refs
(Contract AF 33(608)-1088)
(AD-620448)

The techniques of cascade synthesis to driving-point impedances are extended to the RL case by means of RC-ideal gyrator networks, and cascade synthesis procedures are devised for the realization of RLC and RL driving-point impedances by means of RC-nonideal gyrator networks. The basic properties of ideal and nonideal gyrators are discussed. The major contributions in the field of cascade synthesis by ideal gyrators are reviewed. A procedure for the realization of any RL driving-point impedance by means of a single ideal gyrator in cascade with an RC network is developed. Cascade synthesis procedures are developed for realizing driving-point impedances by RC-nonideal gyrator networks. A method of removing resistance from a function by applying the positive real criteria to the function is presented. TAB

N65-36589# Hughes Aircraft Co., Oceanside, Calif. Vacuum Tube Products Div.
**RESEARCH AND DEVELOPMENT OF TWO-COLOR DIRECT VIEW STORAGE TUBE WITH SELECTIVE ERASURE Final Engineering Report, 24 Jun. 1963–23 Apr. 1965**
P. P. Damon May 1965 97 p refs
(Contract NObsr-89452)
(AD-620379)

A direct view storage tube has been developed which is capable of displaying stored information in either of two colors or in intermediate hues, and selectively erasing that information. The operating principle is based on the fact that flood electrons, which pass through holes in the storage mask when the storage surface potential is near cutoff, fall within small areas on the viewing screen opposite the storage mask holes; whereas flood electrons which pass through the holes when the potential is near its minimum, (i.e., flood gun cathode potential), fall on larger overlapping areas of the viewing screen. The viewing screen consists of two phosphors. This tube is ten inches in diameter. It differs from the tube developed under that contract in that a selective erase feature has been added and an axial flood gun is utilized. Included in this report are results of the twenty-five tubes constructed during the program. A tabulation of actual performance versus objective performance is summarized for several of the later tubes. Author

N65-36629# Polish Academy of Sciences, Warsaw. Inst. for Nuclear Research.
**PREPARATION OF GERMANIUM γ-SPECTROMETERS BY LITHIUM-DRIFT METHOD [POLUCHENIYE GERMANIYEVYKH SPEKTROMETROV γ IZLUCHENIYA PO METODU DREIFA IONOV LITIYA]**
1964 14 p refs In RUSSIAN; ENGLISH summary
(Rept.-592/II/PL) CFSTI: HC $1.00/MF $0.50

Germanium diodes for gamma ray spectrometry using the lithium ion drift technique and p-type germanium have been fabricated. Active depths up to 1.5 mm were obtained. The gamma spectrum of source radioactive elements using these detectors (working at 90° K) are presented. The resolution for $Hf^{181}$ (γ-energy of 615 keV) is 7.2 keV and for $Co^{60}$ (γ-line of 1333 keV) is 12 keV. Author

N65-36630# Polish Academy of Science, Warsaw. Inst. of Nuclear Research.
**A FAST MULTIPLE COINCIDENCE CIRCUIT USING AVALANCHE TRANSISTORS**
Josef Kalisz Jan. 1965 27 p refs
(Rept.-594/IA/PL) CFSTI: HC $2.00/MF $0.50

A simple and reliable coincidence circuit using transistors working in the avalanche mode is described. Using the 56 AVP photomultipliers, the NE 102 plastic scintillator and the $Po^{210}$ oc-rays source, the minimum resolving time is 0.7 nanosecond with 80 percent efficiency and maximum 15 nanoseconds with 100 percent efficiency. Both the number of coincidence channels and the resolving time of the circuit can be selected independently. Author

N65-36653# Crystalonics, Inc., Cambridge, Mass.
**PRODUCTION ENGINEERING MEASURE TO IMPROVE PRODUCTION TECHNIQUES AND TO INSURE THE RELIABILITY OF THE C600 SERIES FIELD EFFECT TRANSISTORS Final Report**
[1964] 150 p
(Contract DA-36-039-AMC-01483(E))
(AD-617401)

This report is the final engineering report of a production engineering measure for the improvement of production techniques to increase the reliability of a silicon Field-Effect Transistor line. Work was performed in specific areas resulting in improved processing techniques. Process operation instructions are included. Program conclusions based upon the work performed are also provided together with a narrative discussing all aspects of the program. All test data and information are summarized. Author

N65-36731# Chalmers Univ. of Technology, Goteborg (Sweden). Research Lab. of Electronics.
**ANOMALOUS NOISE PEAK IN ADLER TUBES**
O. Nilsson 1965 19 p refs
(Contract AF 61(052)-594)
(RR-51; RADC-TR-65-322; AD-619059)

An experimental investigation of the noise stripping mechanism in two Adler tubes with high residual gas pressure ($> 10^{-6}$ mm Hg) has revealed the presence of an anomalous noise peak ($> 1000°$ K). The peak occurs at a frequency somewhat lower than the cyclotron frequency. It is proposed that the peak is produced by elastically scattered beam electrons traveling slowly through the input coupler. The phenomenon is described in terms of an idealized theory which is in good agreement with the experimental findings. Author

**N65-36744#** Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.
**OXIDE MASKED EPITAXIAL FIELD EFFECT TRANSISTORS Final Report, 19 Apr. 1963–31 Aug. 1964**
Marvin Miller, Brian Dale, Roy Yee, and Stanley Karandanis Jul. 1965 81 p
(Contract AF 30(602)-3048)
(RADC-TDR-64-498; AD-620914)

This report describes work performed in developing a unipolar field effect transistor in which the channel is in a thin film of silicon epitaxially grown on silicon of the opposite polarity type. Fabrication was performed of units in which the channels were grown within windows in a surface oxide film, and also units in which the channel layer was grown over the entire slice and an oxide-masked diffusion then used to isolate and localize channel regions of the individual units. Techniques involved in the areas of fabrication and epitaxial growth in both methods were thoroughly explored. A theoretical impurity distribution was calculated for each fabrication process, and the relationship of these calculated distributions to the actual distributions in the devices is discussed. Characteristics of devices resulting from both methods of fabrication are reported. A discussion of problems occurring during the contract work is presented. Author (TAB)

**N65-36745#** Microwave Electronics Corp., Palo Alto, Calif.
**ONE WATT CW S-BAND TRAVELING-WAVE TUBE WITH 6 DB NOISE FIGURE Interim Report No. 2, Sep.–Dec. 1963**
Aug. 1965 25 p
(Contract AF 30(602)-3025)
(RADC-TR-64-535; AD-620853)

Objectives during this period were to evaluate Cathaloy A-33 as a cathode base material, find the effect of cathode activation and processing on noise figure, and make preliminary electron-gun evaluations at high current densities. Cathaloy A-33 exhibited excellent characteristics up to 900 hours life; however, it does not appear to be superior to 220 Ni. Analysis of the effect of proper activation and processing of the cathode was started but not completed. More test vehicles are needed for proper evaluation. Tests on a low-voltage input helix were encouraging and a velocity taper on the output helix improved the saturated power output. An electron gun was scaled, utilizing the current density and voltage from a previous model, and the gun structure changed to allow closer spacing between electrodes. This gun is being fabricated and has not been tested. Author (TAB)

**N65-36746** Marquardt Corp., Van Nuys, Calif.
**ASSOCIATIVE TAG MEMORY Final Report, Jul. 1964–Apr. 1965**
Ralph W. Hass and Earl H. Blevis Griffiss AFB, N. Y., RADC, Jul. 1965 90 p refs
(Contract AF 30(602)-3471)
(RADC-TR-65-178; AD-620915)

A research and development program was conducted to demonstrate the principle feasibility of utilizing ferroelectric and photoconductor elements to implement an associative tag memory. An analytical study was performed to provide an insight to the various design tradeoffs of implementation. A material effort was directed toward producing both thin film and single crystal materials. A small breadboard model was constructed which demonstrated the ability of a string of photoconductor and ferroelectric elements to provide signal indication for various match conditions. A logic utilizing this implementation was developed for a number of inquiry commands.
Author (TAB)

**N65-36790#** Naval Ordnance Lab., Corona, Calif.
**PROCEDURE FOR DEVELOPING OPTIMUM-BANDWIDTH WAVEGUIDE-TO-COAXIAL ADAPTERS**
F. Camphausen, Jr. 6 Aug. 1965 15 p refs
(NAVWEPS-8815; AD-620380)

A simplified procedure for developing 10- to 30-GHz waveguide-to-coaxial adapters that have an optimum bandwidth is described. The procedure is mainly experimental but the shorting-plunger position is preset to the optimum bandwidth value as theoretically determined. Design details of a 17-GHz adapter with a subminiature connector are given. The effects of manufacturing tolerances on adapter performance are discussed.
Author (TAB)

**N65-36829#** Naval Ammunition Depot, Crane, Ind.
**INFORMATION ON MICROELECTRONICS FOR NAVY EQUIPMENTS $\mu$-Notes No. 12**
1 Jun. 1965 77 p refs
(NAD-Crane-65-451; AD-618094)

Epitaxial studies (Part III); Resume on MOS field effect analysis; Evaluation of signetics analog semiconductor integrated circuits; Evaluation of sprague digital semiconductor integrated circuits; Evaluation of siliconix digital semiconductor integrated circuits in an adder/subtractor configuration; Microelectronic approach to the design and development of the AN/ARC-104 (XZ-2 and XZ-3); Compilation of semiconductor integrated circuits evaluated to date. TAB

**N65-36844#** Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
**FREQUENCY MULTIPLIER Quarterly Report, 1 Mar.–31 May 1965**
Gediminas P. Kurpis and Jesse J. Taub [1965] 22 p
(Contract DA-28-043-AMC-00438(E))
(QR-2; AD-619085)

The primary emphasis during this quarter was placed on designing a 50 to 100 Gc doubler and a 1.04 Gc X 8 step recovery diode multiplier. Since the newly designed cross-guide 50 to 100 Gc doubler model was not completed, the special Varad varactor had been used in another modified in-line doubler mount. Small doubler output near 100 Gc was obtained during the preliminary tests of this unit. The step recovery diode multiplier was constructed and tested during this quarter, but it did not perform well as a result of spontaneous parametric oscillations and other circuit problems enumerated later in this report. Alterations are now being made to eliminate these disturbances. Author (TAB)

**N65-36850#** Litton Industries, San Carlos, Calif. Research Lab.
**RESEARCH ON NOISE IN CROSSED-FIELD GUNS Quarterly Report, 1 Apr.–30 Jun. 1965**
R. P. Wadhwa 11 Aug. 1965 9 p refs
(Contract NObsr-89546)
(QR-8; AD-619088)

Noise-figure versus frequency characteristics and correlation of other data in the previous hot testing indicated the necessity of improving VSWR characteristics. The tube was opened and window assemblies were modified; along with this the uniformity of spacing between the vanes resulted in improved VSWR characteristics. During the hot testing period a partial leak developed between the heater and the cathode; this prevented us from obtaining low-noise results. Output characteristics indicated a strong 60 c/s component resulting in large values of noise figure. Tube was opened again and a completely new gun assembly was installed in the tube. The various data obtained during this period and from the hot testing of the tube will be presented in the final report, which is now being completed. Author (TAB)

**N65-36858#** Texas Instruments, Inc., Dallas.
**PRODUCTION ENGINEERING MEASURES (PEM) FOR A GERMANIUM MICROWAVE TRANSISTOR Quarterly Progress Report No. 2, 30 Sep.–31 Dec. 1964**
C. L. White, G. D. Johnson, and R. L. Petritz [1964] 136 p refs
(Contract DA-36-039-AMC-03632(E))
(TI-03-65-09; AD-614799)

The 1.5 Gc and 3.0 Gc noise figure of planar germanium devices using the L-78A pattern is typically 4.8 dB and 9.5 dB, respectively. The L-78A device's $f_T$ value at low emitter currents was below expectation considering the magnitude of reduction of apparent emitter area from the parent L-78 pattern. Limited data on planar L-78A devices using a modified emitter alloying process showed an $f_T$ increase at 2.0 mA from 1700 Mc to 1950 Mc. Additional material is being processed using the new emitter alloying process to verify the reproducibility of the technique. Problems encountered during the latter part of the second quarter in material processing have hampered efforts directed toward device improvement and technique reproducibility. A new pattern—designed L-93A—in comparison with the L-78A, features a smaller emitter, closer spacing between the emitter and base stripes, reduced base diffusion area, and smaller expanded contacts. Preliminary data have been obtained on the contribution of the base stripe contact resistance to the total value of the extrinsic-base resistance. The generator source impedance, for measuring noise figure of the germanium device is considered. Optimum generator impedance for measuring noise figure at 1.5 Gc is computed to be approximately 83 ohms. Quality and reliability assurance data on Group B inspection of planar L-78 devices are analyzed. Author

# 10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

**N65-35962*#** Stanford Univ., Calif.
**STABILITY ANALYSIS OF RELAY-CONTROL SYSTEMS VIA THE DIRECT METHOD OF LYAPUNOV**
Stein Weissenberger Washington, NASA, Oct. 1965 87 p refs
(Grant NsG-133-61)
(NASA-CR-320) CFSTI: HC $3.00/MF $0.75 CSCL 09C

This thesis presents a new computational technique for constructing Laypunov functions for estimating the domain of asymptotic stability of non-linear control systems. A machine program assigns figures of merit (based on the size of the stability-boundary estimates) to the members of a set of Lyapunov functions and then searches for the one which maximizes this measure. The method is applicable to a wide variety of non-linearities but it is principally applied in this thesis to relay-control systems, which are not tractable by other systematic techniques such as the method of Zubov. The numerical results of a number of second- and third-order examples are presented, including one example with non-linear plant dynamics and one example with a saturation characteristic in place of the relay. The method of constructing Lyapunov functions demonstrates marked advantages in that it is not limited to second-order systems, it is not restricted to smooth or even continuous non-linearities, and it effectively utilizes the resources of high-speed machine computation. Author

**N65-36007*#** National Aeronautics and Space Administration, Washington, D. C.
**PUBLISHED PAPERS ON PROBLEMS ON THE BORDERS OF THEORETICAL ELECTRICAL ENGINEERING AND MATHEMATICS**
Stanislaw Bellert Warsaw, Central Inst. for Sci., Tech. and Econ. Inform., 1965 262 p refs Transl. into ENGLISH from Polish
(NASA-TT-F-134; TT-63-11364) CFSTI: HC $6.00/MF $1.50 CSCL 12A

CONTENTS:

1. ON THE CONTINUATION OF THE IDEA OF HEAVISIDE IN THE OPERATIONAL CALCULUS p 3–31 refs (See N65-36008 24-19)
2. NUMERICAL OPERATOR METHOD p 36–101 refs (See N65-36009 24-19)
3. THEORY AND DESIGN OF SAMPLED-DATA CONTROL SYSTEMS p 102–173 refs (See N65-36010 24-10)
4. ON SYNTHESIS OF SAMPLED-DATA CONTROL SYSTEMS p 174–196 refs (See N65-36011 24-10)
5. TOPOLOGICAL CONSIDERATIONS AND SYNTHESIS OF LINEAR NETWORKS BY MEANS OF THE METHOD OF STRUCTURAL NUMBERS p 197–224 refs (See N65-36012 24-10)
6. SYNTHESIS OF AN ARTIFICIAL LONG LINE AND AN AMPLIFIER WITH A NEGATIVE IMPEDANCE BY MEANS OF PADE'S APPROXIMATION METHOD p 225–246 refs (See N65-36013 24-10)

**N65-36010*** National Aeronautics and Space Administration, Washington, D. C.
**THEORY AND DESIGN OF SAMPLED-DATA CONTROL SYSTEMS**
*In its* Published Papers on Probl. on the Borders of Theoret. Elec. Eng. and Math. 1965 p 102–173 refs Transl. into ENGLISH from Rozprawy Elektrotech. (Poland), v. 3, no. 4, 1957 p 459–530 (See N65-36007 24-10) CFSTI: HC $6.00/MF $1.50

This paper presents the foundations of the theory and the principles on designing sampled-data control systems. The paper consists of three parts: Part I is concerned with basic information concerning the mathematical method on which is based the analysis of sampled-data systems; Part II covers the principles of the theory of sampled-data systems containing no feedbacks; in Part III an outline is given of the theory and principles of designing sampled-data control systems. Author

**N65-36011*** National Aeronautics and Space Administration, Washington, D. C.
**ON SYNTHESIS OF SAMPLED-DATA CONTROL SYSTEMS**
*In its* Published Papers on Probl. on the Borders of Theoret. Elec. Eng. and Math. 1965 p 174–196 refs Transl. into ENGLISH from Arch. Automatyki i Telemechaniki (Warsaw), v 2, no. 1-2, 1957 p 95–120 (See N65-36007 24-10) CFSTI: HC $6.00/MF $1.50

A synthesis method of sampled-data control systems on the basis of the frequency pattern is presented in the present paper. The method makes use of the properties of frequency and time characteristics concerning a sampled-data control system as discussed and established herein. Author

**N65-36012*** National Aeronautics and Space Administration, Washington, D. C.
**TOPOLOGICAL CONSIDERATIONS AND SYNTHESIS OF LINEAR NETWORKS BY MEANS OF THE METHOD OF STRUCTURAL NUMBERS**
*In its* Published Papers on Probl. on the Borders of Theoret. Elec. Eng. and Math. 1965 p 197–224 refs Transl. into ENGLISH from Arch. Elektrotech. (Warsaw), v. 12, no. 3, 1963 p 473–500 (See N65-36007 24-10) CFSTI: HC $6.00/MF $1.50

Two problems are discussed in the paper, namely: (1) formalization of the concept of a system, and (2) analysis and synthesis of linear systems by means of the algebra of structural numbers. As regards the first problem, the author has considered three different models of a system, namely, an abstract model, a topological model and a concrete (physical) model. A concept of the topological structure of a system and a concept of similar systems have been discussed along with other ones. As regards the second problems, a new method is presented, namely, the so-called algebra of structural numbers. It facilitates the analysis of linear electric systems and makes it possible to solve the problem of synthesis of a two-terminal or a four-terminal network in a general manner. By making use of a digital computer, we can find a set of systems with different structures which realize a given impedance function or a transfer function. The algebra of structural numbers can also be applied, aside from electrical engineering, to solving linear algebraic equations. Moreover, it gives us a very simple algorithm for determination of all possible trees of a graph or a multigraph. Author

**N65-36013*** National Aeronautics and Space Administration, Washington, D. C.
**SYNTHESIS OF AN ARTIFICIAL LONG LINE AND AN AMPLIFIER WITH A NEGATIVE IMPEDANCE BY MEANS OF PADE'S APPROXIMATION METHOD**
*In its* Published Papers on Probl. on the Borders of Theoret. Elec. Eng. and Math. 1965 p 225–246 refs Transl. into ENGLISH from Arch. Elektrotech. (Warsaw), v. 8, no. 4, 1959 p 595–615 (See N65-36007 24-10) CFSTI: HC $6.00/MF $1.50

Two problems are discussed in the paper; the first concerns the synthesis and design of a passive electric system realizing frequency patterns of a transmission long line—that is, the characteristics of the impedance and the composite transfer coefficient of the long line. A system designed on the basis of the method presented realizes long line characteristics in a frequency band six times wider than does a similar system designed by the method of Zobel [3], the same number of elements being used. The second problem concerns a method for designing a nonreflecting four-terminal amplifier with a negative impedance (negistor), which compensates the attenuation and amplitude-phase distortions of a long line. This method, which is based on the conclusions from the first part of the paper, makes it possible, for example, to design a system decreasing the attenuation of a transmission long line 15 km in length within a band up to 6 kHz. Author

**N65-36179#** Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
**DISTORTION OF A MAGNETIC FIELD BY THE MOTION OF A CYLINDRICAL CONDUCTOR**
Joseph G. Kelley and Ronald S. Finn Jun. 1965 27 p refs
*Its* Physical Sci. Res. Papers No. 114
(AFCRL-65-440; AD-620229)

Motion of a conductor relative to a magnetic field distorts the field. This paper considers a cylindrical slug moving in a two-dimensional magnetic field, represented by the vector potential $A_0 \hat{\theta}$, where $\delta A_0/\delta \theta = 0$. Maxwell's equations are solved for the distorted potential $A \hat{\theta}$ in the form of a rapidly converging series $A = \Sigma A_n$. The $A_n$'s are given in a form suitable for evaluation by a digital computer. The nonequivalence of the apparently analogous problem of a stationary slug in a time-varying field is noted and discussed. Author

**N65-36291#** Pacific Naval Lab., Esquimalt (British Columbia).
**DESIGN OF ACTIVE THOMSON FILTERS USING TABLES**
R. C. Weir May 1965 35 p refs
(PNL-TM-65-2; AD-466203)

A method of designing active RC filters by means of tables is presented. Low pass and high pass filters can be designed in this manner and by connecting them in tandem, band pass filters can be produced. Author

**N65-36299#** Case Inst. of Tech., Cleveland, Ohio.
**TRANSFER MATRIX SYNTHESIS USING ACTIVE RC NETWORKS Scientific Report No. 9**
Dov Hazony and Roy D. Joseph 1 May 1965 70 p refs
(Contract AF 09(628)-1699)
(AFCRL-65-405; AD-620735)

Necessary conditions are established for the voltage transfer matrix of a transformerless grounded network composed of ideal resistors, inductors, capacitors (RLC), and grounded unity gain amplifiers. These conditions are also shown to be sufficient for realization as the voltage transfer matrix of a transformerless grounded network containing RC and not more than one grounded unity gain amplifier per matrix row. Similar necessary and sufficient conditions are presented for transformerless grounded input, nongrounded output networks composed of these same passive and active elements. The grounded input, nongrounded output case requires not more than two grounded unity gain amplifiers per matrix row for its synthesis. In the two-port nongrounded case a special procedure makes it possible to realize the transfer function by the proper connection of two identical three-terminal networks. Author

**N65-36303#** Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
**BASIC CONTROL THEORY. SENSITIVITY OF OPTIMAL CONTROL SOLUTIONS**
Mar. 1965 61 p refs
(Contract DA-ARO(D)-31-124-G-193)
(ESL-FR-239; AROD-3365-6; AD-619223)

The investigations have been in three areas: Optimization Theory, Adaptive Control, and Nonlinear and Time-Varying Systems. In each of these areas, the particular problems investigated, together with the results and conclusions, are briefly reviewed. The second section of this report is an investigation by Pierre R. Belanger, where it is assumed that

a control function is known which drives the state of a system from some initial value to a given target set. The effect of using a control "close" to this nominal control function is investigated. Two types of control perturbations, called "continual" and "intermittent" are defined. A control perturbation is continual if the perturbed control and the nominal control differ by a small amount at any time. A perturbation is "intermittent" if the perturbed control and the nominal control differ by large amounts, but only during small time intervals. Author

N65-36327# Naval Postgraduate School, Monterey, Calif.
**DISCONTINUOUS OPERATION OF LINEAR FEEDBACK CONTROL SYSTEMS**
Farel M. Parapat (Ph.D. Thesis) 1964 299 p refs
(AD-620299)

Several methods to decrease the time response of feedback control systems have been developed. In this paper, a relatively easy method for decreasing the total time response is introduced. The method can be applied to linear position control system of any order. The systems may have real poles, real zeros, complex poles and complex zeros, as long as there is freedom to have one kind of switch between elements, and another kind of switch to inject signals into the elements during certain intervals of time. Application of the method to systems with ramp input and effects of some nonlinear components are also investigated. The switching computer required to operate the switches is very simple; the switches can be opened and closed at the right time, by comparing the input signal to the output signal in the switching computer; the output velocity signal may be required to increase the sensitivity of the switching computer. For any system of any order, the same components of the switching computer can be applied. Author

N65-36397*# Purdue Univ., Lafayette, Ind. Electronic Systems Research Lab.
**[LEARNING SYSTEMS, ADAPTIVE SYSTEMS AND SIGNAL DESIGN] Semiannual Report, Jan. 1–Jun. 30, 1965**
[1965] 43 p refs
(Grant NsG-553)
(NASA-CR-67507) CFSTI: HC $2.00/MF $0.50 CSCL 09C

Several developments are reported in continuing studies on learning systems, adaptive systems, and signal design. Areas of research include simulated learning systems; learning probability spaces for pattern classification and recognition with or without supervision; synthesis of optimum receivers for m-ary channels with extensive intersymbol interference; cognitive signal processing; generalized kineplex system; self-synchronizing receivers; adaptive processing of troposcatter data; troposcatter signal design; and digital communication systems optimization for channels with memory. Details are given on several projects, such as the development of an optimum iterative solution for a nonsupervisory problem in which a mixture problem approach was used and the Bayes theorem applied; the introduction of an a posteriori weighting matrix concept which holds for the general problem of observing a markov source through a noisy channel; and a model for a binary communication system. M.G.J.

N65-36459# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
**ON GAIN-BANDWIDTH LIMITATIONS FOR PHYSICALLY REALIZABLE SYSTEMS**
M.R. Wohlers Jan. 1965 28 p refs
(RM-261J)

Gain-bandwidth limitations for certain physical systems have been obtained in integral form by employing a generalized representation theorem for bounded-real functions. These systems are characterized by the fact that certain portions of them are fixed or prescribed. The primary interest of the paper is the determination of how the fixed portion limits the over-all performance of the system; and, in particular, the gain-bandwidth constraints for input-output functions. A principal feature of the procedure, and of the specific results quoted, is that they apply (within assumptions such as linearity, time-invariance, etc.) to extremely general systems. For example, no restriction such as rationality (lumped, finite systems) is imposed. The examples considered (wideband matching, optimization of laser amplifier, etc.) have been selected either for their current interest or the generality of the statements which can be made concerning them. Author

N65-36464# Grumman Aircraft Engineering Corp., Bethpage, N.Y. Research Dept.
**A DISTRIBUTIONAL STUDY OF THE REAL FREQUENCY BEHAVIOR OF PASSIVE SYSTEMS**
M.R. Wohlers Sep. 1965 8 p refs Presented at the Allerton Conf. on Circuit and System Theory, Illinois Univ., Urbana, 20–22 Oct. 1965
(RM-294J)

The purpose of this paper is to present two theorems that constitute a realizability theory for passive n-ports in which all statements are given directly on the real frequency axis. To achieve the generality desired, i.e., to consider more general systems than rational ones, the theory of distributions has been used as the vehicle for the analysis. Author

N65-36516# Materials Research Corp., Orangeburg, N.Y.
**IRON SINGLE CRYSTAL PREPARATION. PART I: THE PREPARATION OF THE CRYSTALS AND A STUDY OF THEIR MECHANICAL AND ELECTRICAL PROPERTIES AT LOW TEMPERATURES. PART II: SOME EXPERIMENTS ON THE USE OF THE ELECTROTRANSPORT PHENOMENON FOR THE FURTHER PURIFICATION OF ELECTRON BEAM ZONE REFINED IRON Final Report, Apr. 2, 1963–Apr. 1, 1964**
E.J. Hughes, P.W. Barton, and R.D. Vigue [1964] 33 p refs
(Contract AT(30-1)-2980)
(MRC-489)

A strain anneal method for the preparation of single crystals from polycrystalline electron beam zone-refined iron is described. The tensile properties of crystals having orientations covering the whole stereographic triangle were studied at −196° C. The results obtained differed strongly from those obtained by earlier workers using less pure crystals in that ductility was observed in all orientations. Electrical resistance measurements made at room temperature and 4.2° K gave resistance ratio values for the crystals of between 200 and 300. An apparatus was constructed which allows heavy currents to be passed through a metal rod whilst it is maintained in a vacuum or inert atmosphere and its ends are kept near room temperature by water cooling. This apparatus was used to study the possibility of using the electrotransport phenomenon for the further purification of electron beam zone-refined iron. A series of iron specimens were prepared from a single rod of electron beam zone-refined iron which contained a total impurity content of about 50 ppm. A direct current of 70 amps was passed through each of three of the specimens for a period of 72 hours. During this period the specimen was maintained in an atmosphere of pure hydrogen and, as a result of Joule heating, its midpoint was at a temperature of about 1300° C. Similar experiments were carried out on two further specimens using alternating instead of direct current. The impurity distribution along the lengths of each of these five specimens was examined by

making resistance ratio measurements. By comparing the results from the D.C. and A.C. experiments it was possible to separate out effects due to the Sóret effect from those due to electrotransport. In this way it was found that in the D.C. experiments electrotransport had caused a measurable movement of impurities away from the anode. This effect was, however, small compared to the Sóret diffusion which accompanied it. These results are therefore discouraging from the point of view of developing a purification technique. The behavior of the impurity distributions in the five rods on annealing was studied by repeating the resistance ratio measurements after successive 2 hour vacuum annealing treatments at 200, 350, 450, and 650° C. Annealing at 200° C produced an overall increase in the resistance ratios and this was not significantly altered by the 350 and 450° C anneals. The 650° C anneal, however, produced an overall decrease in the resistance ratios of about the same magnitude. Author

**N65-36521#** Bettis Atomic Power Lab., Pittsburgh, Pa.
**THIRD ORDER TIME-VARYING SYSTEMS**
W. C. Bean Mar. 1965 8 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-T-1695)

In the study and design of automatic control engineering in which time-varying systems arise, phenomena occur which are described by differential equations having coefficients that vary with time. As a result of this variation in one or more coefficients, the solutions of these equations and the behavior of the systems they describe seem strange relative to the equations with constant coefficients so frequently studied. As more inclusive and elegant nonlinear analysis methods are developed, nonlinear differential equations can be investigated. R.W.H.

**N65-36700#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**TREATMENT OF LINEAR MULTIVARIABLE CONTROL SYSTEMS BY APPLICATION OF DETERMINANTS FROM SIMPLE FIXED SWITCHING BOARDS [DIE BEHANDLUNG LINEARER MEHRFACHREGELSYSTEME MIT HILTE VON DETERMINANTEN AUF DER BASIS DES VERALLGEMEINERTEN BLOCKSCHALTBILDES]**
Rudolf Starkermann (Ph.D. Thesis) Juris-Verlag, 1964 150 p refs In GERMAN
(Rept.-3502) CFSTI: HC $4.00/MF $1.00

A simplified block diagram of multi-channel control systems was used to find the determinants for special problems. The partial elimination of variables was demonstrated by calculations and formation of a comprehensive industrial control complex consisting of various transfer elements. Single blocks of the complex represented the Laplace transformation between entrance and exit functions of the system transmission elements. Transl. by G.G.

**N65-36857#** Stanford Univ., Calif. Microwave Lab.
**STUDY OF PARALLEL PUMPING IN MICROWAVE FERRITES**
M. Omori Dec. 1964 17 p refs
(Contract Nonr-225(48))
(ML-1275; AD-614045)

The degenerate parallel pumping of the ferromagnetic resonance in microwave ferrites was investigated. Pump strength below and above the instability threshold were studied. The linearized equation is used for deriving the transverse susceptibility under the parallel pump condition. The effective transverse linewidth under the degenerate parallel pump condition is a function of the pump strength and the effective transverse susceptibility is a function of the pump strength and the phase angle between the parallel pump field and the transverse driving field. When the phase angle is chosen for pumping the system, the effective susceptibility becomes infinite at the threshold of the parallel field. When the parallel field strength is above the threshold, the effective susceptibility becomes negative and the system becomes unstable. Experiments were performed on disk and sphere shaped samples of single crystal YIG material, and good agreement between theory and experimental results were obtained for one of the magnetostatic modes in the spherical sample. Theory, experiments, and results are also included on the mixing of parallel and transverse fields and relaxation oscillations. R.N.A.

# 11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

**N65-35956*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**A NOTE ON WIRE IGNITION IN COMBUSTION-HEATED DRIVERS FOR SHOCK-TUNNEL APPLICATION**
David A. Stewart and Robert E. Dannenberg Washington, NASA, Oct. 1965 26 p refs
(NASA-TN-D-3063) CFSTI: HC $1.00/MF $0.50 CSCL 14B

The problem of operating a large combustion driver is principally that of obtaining detonation-free combustion. Certain factors that influence the performance of a wire ignition system and the consistency in the initiation of the combustion process are described. These factors are based on operating experience with a large volume driver. A semi-empirical method which describes the physical reaction of the wires and provides a correlation between the electrical and thermodynamic energy necessary to melt the wires is presented. It is shown that wire melting, not exploding, is required for detonation-free combustion in a large driver chamber. Author

**N65-36162#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PHOTOELECTRIC DYNAMOMETER FOR TURBOMACHINES**
V. S. Davydov 20 Aug. 1965 11 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 8, 1964 p 41–43
(FTD-TT-65-678/1+2+4; AD-620769)

A highly sensitive photoelectric torsion dynamometer developed for the measurement of torque transmitted to the working wheel of a turbocompressor is described. The dynamometer is reliable during long lasting operation and assures high measurement accuracy at low and high speeds to 20000 to 50000 rpm. The error of measurement was determined by the static calibration of the instrument to be 0.5 to 0.7%. E.E.B.

**N65-36168#** Oklahoma Univ., Norman. Graduate College.
**OPERATION OF A DUOPLASMATRON ION ACCELERATOR AS A HIGH ENTHALPY WIND TUNNEL**

William H. Klecker (M.S. Thesis) 1965 48 p refs
(Contract AF 33(608)-1096)
(AD-620387)

The purpose of this thesis is to provide future operators of the Duoplasmatron with a general reference which will enable them to maintain the wind tunnel being developed and to adapt it to any particular line of investigation. It also contains a set of procedures by which the tunnel should be operated. Author

**N65-36253#** Technology, Inc., Dayton, Ohio. Applied Sciences Div.
**DISTORTION ANALYSIS OF THE ACCELERATION PRODUCED BY THE WESTERN GEAR CORPORATION MODEL 4010 HIGH AMPLITUDE VIBRATION MACHINE Final Report, Jun.–Sep. 1964**
Frank P. Primiano, Jr., Richard D. Lowry, and Neville P. Clarke (AMRL) Wright-Patterson AFB, Ohio. AMRL, Apr. 1965 35 p
(Contract AF 33(615)-1894)
(AMRL-TR-65-27; AD-620319)

The acceleration environment produced by the 4010 high amplitude vibration machine was surveyed at even fundamental frequency from 2 to 20 cps at two levels of acceleration, 1 G and 2 G. The frequency components of the motion up to 50 cps were determined by a M-H 9050 automatic wave analyzer and are presented in the form of harmonic distributions for each fundamental. The "total distortion figure" and "overall distortion figure" are used as measures of the fidelity with which the acceleration wave approximates a pure sine wave of the fundamental frequency. The data dictated that the 1 G acceleration was more distorted than the 2 G and that at both levels the distortion increased with frequency. Author

**N65-36273#** Massachusetts Inst. of Tech., Cambridge. Lab. for Insulation Research.
**ELECTRON-IONIZATION CROSS SECTIONS Semiannual Progress Report, Dec. 16, 1964–Jun. 15, 1965**
C. K. Crawford and F. M. Roddy Wright-Patterson AFB, Ohio, Res. and Technol. Div. [1965] 29 p refs
(Contract AF 33(657)-10939)
(SAPR-4; AD-620289)

Construction of a new crossed beam ion source is described in considerable detail. The source takes advantage of the new parts, and incorporates the wire-wound ionization chamber with all sides flashable. Work continued on the electron monochromators. Author

**N65-36325#** Burns and Roe, Inc., New York.
**DEVELOPING AND TESTING THE ADVANCED POWER CONVERSION EXPERIMENTAL FACILITY, VOLUME I Final Technical Report, May 1, 1963–Jun. 30, 1965**
John W. Stribling Aug. 1965 696 p refs
(Contract DA-44-009-AMC-179(X))
(AD-620115)

This report describes the experimental testing and the results achieved, the operations, development and maintenance work accomplished, the designs prepared and implemented, and the test planning studies made for the Advanced Power Conversion Experimental Facility at Fort Belvoir, Virginia, from 1 May 1963 to 30 June 1965. The system and component performance investigations and evaluations that were completed are detailed. The training and education program for operating personnel and the administrative procedures and instructions developed and recommendations as to the programs and tasks to be pursued in the immediate future for continued progress along the planned lines of development of the facility are outlined. Author

**N65-36326#** Burns and Roe, Inc., New York.
**DEVELOPING AND TESTING THE ADVANCED POWER CONVERSION EXPERIMENTAL FACILITY, VOLUME 2 Final Technical Report, May 1, 1963–Jun. 30, 1965**
Aug. 1965 109 p Drawings
(Contract DA-44-009-AMC-179(X))
(AD-620137)

The as-built drawings are presented for the advanced power conversion experimental facility at Ft. Belvoir, Virginia. M.G.J.

**N65-36350*#** National Aeronautics and Space Administration, Washington, D. C.
**NASA'S TECHNOLOGY UTILIZATION PROGRAM**
[1965] 18 p
(NASA-TM-X-56872) CFSTI: HC $1.00/MF $0.50 CSCL 05B

Means of disseminating information about NASA's mission, research endeavors, and technological advances are considered in terms of utilization by technical personnel. Discussed are the three basic services of the regional dissemination centers: (1) monthly searches of tapes dealing with technical reports and journal articles for information of possible value to center clients; (2) complete searches of the entire collection of more than 200 000 documents; and (3) distribution of technical publications to member companies on a weekly basis. The areas in which NASA conducts research and collects reports, the kinds of reports that are available, some of the results of the technology utilization program, and patents and licenses are considered. Procedure for obtaining the benefits of the program is given. M.W.R.

**N65-36427*#** Ampex Corp., Redwood City, Calif.
**ANALYZATION, DESIGN, FABRICATION AND TESTING OF A FOIL BEARING ROTOR SUPPORT SYSTEM Quarterly Technical Report, Period Ending 21 Aug. 1965**
A. F. Stahler 15 Sep. 1965 23 p refs
(Contract NASw-1221)
(NASA-CR-67540; RB-65-40) CFSTI: HC $1.00/MF $0.50 CSCL 14B

The design of the high-speed, self-acting, gas-lubricated, foil-bearing, rotor-support test rig has been completed. This test rig has been designed for a maximum rotational speed of 570 000 rpm, and it is instrumented to continuously measure shaft speed and shaft motion in two planes, foil tension and wrap angle, and the torque exerted by the rotating shaft on the foil journal bearing. The fabrication and assembly of the test rig is nearly complete. A study of the stress and vibration characteristics of high-speed rotors showed that rotor design was often limited by the first free-free bending critical speed because conventional gas lubricated bearings cannot support a shaft during acceleration through this critical speed. Author

**N65-36428*#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.
**RESEARCH IN GAS-SURFACE INTERACTION. PART II: A SHOCK TUBE DRIVEN MOLECULAR BEAM FOR GAS-SURFACE INTERACTION EXPERIMENTS Final Report, 1964–1965**
Richard A. Oman and Vincent S. Calia Aug. 1965 38 p refs
(Contract NASw-1027)
(NASA-CR-67541; RE-223) CFSTI: HC $2.00/MF $0.50 CSCL 14B

The application of pulsed molecular beams to gas-surface interaction experiments is discussed, making use of the results of experimental investigation of four basic configurations. Low energy gas density was measured directly in configurations

with ionization gauges both on the beam axis and at large off-axis displacements, and the measured density was found in some cases to be greater than that of the high-energy portion of the flow. This low energy gas would make gas-surface experiments impossible. The use of a two-stage skimmer appears to remove these difficulties. Beam divergence angle, intensity, and energy are quite acceptable, and can be predicted with acceptable accuracy by simple calculation methods and scaling laws. Some evidence of unsteadiness during the test interval has been found with the two-stage nozzle, two-stage skimmer configuration, but this is felt to be only a mechanical noise problem in the instrumentation system. Author

**N65-36456#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

**THE GRUMMAN HYPERSONIC SHOCK TUNNEL**

Richard A. Scheuing, Harold B. Hopkins, and Jarvis Leng Jun. 1965 130 p refs

(RE-217)

The Grumman research hypersonic shock tunnel is of the reflector type with a 100 ft long helium driven tube and a 20 ft long driver. Details of the mechanical design development; discussions of the pressure, heat transfer, and optical instrumentation systems; and examples of experimental results are presented. Mach numbers of 9 to more than 20 may be achieved with constant stagnation pressures for 2 to 5 milliseconds. Because of severe attenuation of the incident shock wave, the total enthalpy is limited to about 2000 BTU/lb. Reynolds numbers per foot of approximately $5 \times 10^4$ to $5 \times 10^6$ at Mach 9, and $10^3$ to $10^5$ at Mach 20 are possible. Maximum conditions generated to date have been limited to those useful for aerodynamic testing purposes and include initial shock speeds of 10000 ft/sec, driver pressures of 20000 psi, and reflected shock stagnation pressures of 10000 psi. R.N.A.

**N65-36535#** Oak Ridge National Lab., Tenn.

**A COMPARISON OF MULTI-STAGE FLASH AND LONG-TUBE VERTICAL MULTIPLE-EFFECT EVAPORATORS UNDER IDENTICAL CONDITIONS**

R. Van Winkle 30 Jan. 1964 11 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-826)

Detailed cost estimates of a multi-stage flash evaporator (MSF), and long-tube vertical multiple-effect evaporator (LTV) have been used as a basis for comparing these two types of evaporators. Although the cost estimates were both for one billion gpd plants, the steam temperatures and maximum brine temperatures specified for the two plants were different (mainly because the specifications were written at two different points in time). Hence it was necessary to modify the MSF flowsheet to the steam, maximum brine and sea water temperature conditions of the LTV to permit making a normalized cost estimate for the MSF. Comparison of the systems was made for evaporators using 246° F steam, 230° maximum brine temperature, and 80° F sea water; the LTV had six effects, and the MSF had 42 stages. Although the LTV requires about one-third more heat transfer surface than the MSF, its total construction cost was less—247 million vs 269 million dollars for the MSF. The LTV requires a higher fixed charge rate for interim replacement—about 1 to 1.2% vs about 0.8 to 0.9% for the MSF. The cost of water produced in the LTV of performance ratio 5 lb product/1000 Btu is about 2¢/1000 gal cheaper than that of the MSF. Author

**N65-36567#** Army Dept., Washington, D. C.

**SURFACE DRAINAGE DESIGN FOR AIRFIELDS AND HELIPORTS IN ARCTIC AND SUBARCTIC REGIONS**

10 Aug. 1965 36 p refs Prepared jointly with AF Supersedes TM-5-852-7, Dec. 1954

(TM-5-852-7; ATM-88-19, Ch. 7)

Problems in the design of drainage facilities, and an outline of convenient methods of estimating design capacities for airfield and heliport drainage facilities in arctic and subarctic regions are reviewed. Hydrologic criteria, icings, and design procedures for storm drains are discussed with the aid of supplementary charts and diagrams. G.A.L

**N65-36600#** National Aerospace Lab., Tokyo (Japan).

**DESIGN, CONSTRUCTION, AND CHARACTERISTICS OF FLIGHT SIMULATOR AT NATIONAL AEROSPACE LABORATORY**

Akiyoshi Matsuura, Kazuo Higuchi, Mitsuei Ikeya, Yuso Horikawa, Moriyuki Momona et al 1965 109 p refs in JAPANESE; ENGLISH summary

(NAL-TR-70; UDC-629.13) CFSTI: HC $4.00/MF $0.50

A general purpose flight simulator system was installed at National Aerospace Laboratory in July of 1963. It consists of an analog computer unit, a flight table unit and a moving cockpit unit. This system is used for the research on flight performance, stability and control of aircraft and rocket, involving autostabilizer or human pilot. Various simulation studies on conventional aircraft, V/STOL plane and rocket are now being carried out using this system successfully. In this paper, the system design, construction, and function of each unit including various components are reported here. Author

**N65-36628#** Polish Academy of Sciences, Warsaw. Institute for Nuclear Research.

**MOBILE UNIT FOR DEMINERALIZATION AND PURIFICATION OF REACTOR WATER [PERENOSNOI IONOOBMENNO-MEKHANICHESKII FILTR DLYA OCHISTKI VODY V REAKTORNYKH USTANOVKAKH]**

1964 28 p refs In RUSSIAN; ENGLISH summary

(Rept.-582/XIV,XI) CFSTI: HC $2.00/MF $0.50

Design and hydraulic parameters of the mobile unit for demineralization and purifcation of water in reactor primary system were given, including the results of due measurements. Filter construction was based on the interdependence of the chemical characteristics of reactor water upon the operational requirements for reactors. Author

**N65-36728#** Douglas Aircraft Co., Inc., Long Beach, Calif. Aircraft Div.

**USING A GENERALIZED CONTACT FLIGHT SIMULATOR TO IMPROVE VISUAL TIME-SHARING Final Report, Jun. 1963–Dec. 1964**

Richard F. Gabriel, Alan A. Burrows, and Paul E. Abbott Port Washington, N. Y., Naval Training Device Center, Apr. 1965 80 p refs

(Contract N61339-1428)

(NAVTRADEVCEW-1428-1; AD-619047)

Thirty Marine A-4 pilots were given eight carefully designed time-sharing training sessions in a simple, generalized visual flight simulator and then compared with a control group on performance in the highly specific A-4 operational flight trainer equipped with a visual display. Results indicated improved ability to detect simulated mid-air collision hazards without compromising performance in the other flight tasks. Such training therefore is recommended as an aid in reducing the mid-air collision hazard. Author (TAB)

# 12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-35840*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**EXPERIMENTAL PROFILES OF VELOCITY COMPONENTS AND RADIAL PRESSURE DISTRIBUTIONS IN A VORTEX CONTAINED IN A SHORT CYLINDRICAL CHAMBER**
Joseph M. Savino and Edward G. Keshock Washington, NASA, Oct. 1965 34 p refs
(NASA-TN-D-3072) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Experimental profiles of velocity components and radial pressure distributions in a vortex contained in a short cylindrical chamber were calculated. The resulting profile measurements, taken with a pitot-yaw probe that sensed both the magnitude and direction of the local velocity vectors, showed that all the radial inflow occurred in the regions adjacent to the disk surfaces. A model whereby the tangential velocities inside a vortex are predicted from the measured radial pressure distribution, was checked using both the measured static pressures and tangential velocity data. The pressure distribution that was calculated from a balance of the pressure and centrifugal forces, using the measured tangential velocities, agreed well with the measured static pressure distribution. It was concluded that the tangential-to-radial velocity ratio of the fluid as it is injected into the chamber alone determines what fraction of the total mass flow will be forced to flow inwardly through the end wall boundary layers. G.A.L.

N65-35860 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ON PLASTICITY POSTULATE**
G.A. Gemmerling *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 116–124 refs (See N65-35850 24-23)

A generalization principle is considered in the theory of plasticity. In particular cases it is shown to lead to essential limitations on the permissible form of the function of load. A flow law is obtained, and it is shown to satisfy all the basic conclusions of flow theory. A simplified model which is based on the second invariant of a stress deviator is included. C.T.C.

N65-35866 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**APPROXIMATE CALCULATION OF GAS FLOW IN CHANNELS WITH POROUS WALLS**
V.I. Yagodkin *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 163–169 refs (See N65-35850 24-23)

An approximate method to compute gas flow in channels with porous walls is examined. The compressibility of the gas was taken into consideration. Flow was considered in both plane and constant width channels. It is reported that an experimental check of the conclusions was conducted, and that the approximate theory satisfactorily describes the flow. C.T.C.

N65-35868 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**THE MACH REFLECTION OF SHOCK WAVES**
P. F. Korotkov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 179–184 refs (See N65-35850 24-23)

The configuration of shock waves is considered during Mach reflection from a flat hard wall. Such a problem is self-simulating since any characteristic constant length does not enter into the conditions of the problem. It is shown that the Mach wave cannot too strongly outstrip, or too strongly lag behind the incident wave. At a certain distance from the wall, the incident and reflected waves are connected together in a so-called triple point. From this point, a third shock wave goes to the wall. Thus, during Mach reflection only one wave approaches the wall. Therefore the wave is perpendicular to the wall at the point of intersection. Equations are derived for determining coefficients of reflectivity. C.T.C.

N65-35879# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**GENERALIZED ANALOGY BETWEEN THE MASS-TRANSFER COEFFICIENTS IN A MULTICOMPONENT BOUNDARY LAYER WITH AN ARBITRARY PRESSURE GRADIENT**
B. I. Reznikov and G. A. Tirskiy 4 Aug. 1965 12 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 4, 1964 p 798–801
(FTD-TT-65-543/1+4)

The analogy between the coefficients of mass transfer is generalized for the case of the multicomponent boundary layer with an arbitrary longitudinal pressure gradient and an arbitrary mass flow distribution along the surface. Equations are given for component diffusion and the generalized similarity between the coefficients of mass transfer and the coefficient of heat transfer. E.E.B.

N65-35902# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EXPERIMENTAL INVESTIGATION OF THE WAKE BEHIND A BODY OF REVOLUTION**
L. I. Ilizarova and K. A. Pochkina 25 May 1965 15 p refs Transl. into ENGLISH from Prom. Aerodinamika, Tsentr. Aerogidrodinamicheskiy Inst. (Moscow), no. 23, 1962 p 99–106
(FTD-TT-65-86/1+2; AD-618642)

In an experimental investigation of the turbulent wake behind a body of revolution, measurements were made of the speed in several sections located at various distances from the body, and of the static pressure on the axis of the wake. A closed wind tunnel with an open working area, and a Pitot–Prandtl tube were used. Four values for the speed of the oncoming flow were used for measurements of the wake. The pressure measurement on the axis of the wake showed that, in close proximity to the body, the value for the pressure noticeably differs from the pressure outside of the wake, while the indicated difference rapidly faded out with the distance from the body. Formulas are given for computing the pressure and speed, and the results are applied to obtain the experimental constant needed for computing the axis symmetrical wake. M.G.J.

N65-35915# Library of Congress, Washington, D. C. Aerospace Technology Div.
**MIXING OF INTERSECTING TURBULENT JETS Translations of Soviet-Block Scientific and Technical Literature**
I. S. Makarov and B. G. Khudenko 14 Jul. 1965 7 p Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 8, no. 4, 1965 p 447–450
(ATD-T-65-48; AD-618390)

The results of experiments are given on parameters of the flow (velocity field, static pressures and temperatures) which is formed by intersection of two parallel plane turbulent jets. Author

**N65-35945#** Colorado State Univ., Fort Collins.
**INTEGRATED ARMY METEOROLOGICAL WIND-TUNNEL RESEARCH PROGRAM Final Summary Report, 1 May 1964–30 Apr. 1965**
May 1965 18 p refs
(Grant DA-AMC-28-043-64-G-9)
(CER65JEC30; AD-619042)

The structure over smooth and rough boundaries, structure perturbations produced by a single roughness on a smooth surface, the effect of wall roughness on the structure of the turbulent flow over a flat plate, and the development of a mathematical model for turbulence with planar homogeneity are discussed. Also, fundamental research on diffusion in turbulent shear flow is described. This research considered instantaneous sampling equipment, the measurement of concentration distribution in clouds emitted by instantaneous sources located in a turbulent boundary layer, and the verification of similarity criteria for turbulent diffusion by comparative studies of wind tunnel and field diffusion data. The modeling of mountain lee waves in the wind tunnel and the model wind structure near White Sands Missile Range meteorological tower are considered. E.E.B.

**N65-35951*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**SATISFACTION OF ASYMPTOTIC BOUNDARY CONDITIONS IN NUMERICAL SOLUTION OF SYSTEMS OF NONLINEAR EQUATIONS OF BOUNDARY-LAYER TYPE**
Philip R. Nachtsheim and Paul Swigert Washington, NASA, Oct. 1965 36 p refs
(NASA-TN-D-3004) CFSTI: HC $2.00/MF $0.50 CSCL 20D

A method for the numerical solution of differential equations of the boundary-layer type is presented. The asymptotic boundary conditions are satisfied at the edge of the boundary layer by adjusting the initial conditions so that the mean square error between the computed variables and the asymptotic values is minimized. Convergence to a solution is rapid and appears to be insensitive to the initial guesses of the initial conditions. Use of a least-squares convergence criterion leads to the unique solution even in the case of retarded main stream flows. A description of the method is given, and two examples taken from boundary-layer theory are worked. For the Falkner-Skan differential equation, the relation between the wedge angle and the shear stress at the wall is obtained. Author

**N65-35963*#** Catholic Univ. of America, Washington, D. C.
**ON THE ESTABLISHMENT OF DENSITY PROFILE FOR THE FLOW OF A TWO-FLUID SINGLE PHASE GAS MIXTURE**
Timothy W. Kao Washington, NASA, Oct. 1965 22 p ref
(Grant NsG-586)
(NASA-CR-330) CFSTI: HC $1.00/MF $0.50 CSCL 20D

The establishment of density profile for a two-fluid single phase gas mixture under a body force from a uniformly mixed upstream condition is analysed. The flow is assumed to be two-dimensional and confined between two parallel walls. An inviscid hydrodynamical model is adopted. A perturbation procedure is used to obtain a closed form zeroth order solution. The interplay between Fickian and baro-diffusion is brought out. The problem bears on cavity type gaseous nuclear reactor propulsion device where the critical concentration of the nuclear fuel in a fuel-propellant mixture is important. Author

**N65-35966*#** National Aeronautics and Space Administration, Washington, D. C.
**THE FLOW OF GAS IN CHANNELS IN THE PRESENCE OF HEAT TRANSFER**
M. M. Nazarchuk Nov. 1965 189 p refs Transl. into ENGLISH of the book "Techeniya Gaza v Kanalakh Pri Nalichii Teploobmena" Kiev, Izd. Akad. Nauk Ukr. SSR, 1963
(NASA-TT-F-262) CFSTI: HC $5.00/MF $1.25 CSCL 20D

A one-dimensional theory of the flow of gas in channels in the presence of heat transfer between walls and gas is presented. New methods of calculation based on the theory of the boundary layer are given for the flow of gas in tubes; the conditions of crisis in such flows are examined, and the limits of applicability of Reynolds analogies are indicated. R.W.H.

**N65-35973*#** Meteorology Research, Inc., Altadena, Calif.
**THE MOTION OF ASCENDING AND DESCENDING SPHERES**
Paul B. Mac Cready, Jr. and Robin E. Williamson Huntsville, Ala., NASA. Marshall Space Flight Center, 13 Sep. 1965 35 p refs
(Contract NAS8-5294)
(NASA-CR-61102) CFSTI: HC $2.00/MF $0.50 CSCL 20D

Measurements were made of the self-induced motions of spheres rising or descending in a 35-ft deep water tank. The trials covered various Reynolds number ($R_d$) flow regimes, different relative mass (RM) situations, and different surface roughnesses. At subcritical $R_d$, smooth and small roughness element spheres gave regular motion. The relative mass effect was consistent with the prediction that the lateral motion total amplitude is proportional to (diameter) $(1+2\ RM)^{-1}$. In all $R_d$ regimes the large roughness element spheres had regular motion of small amplitude. At critical and supercritical $R_d$, smooth spheres had large irregular wandering motions and spheres with small roughness elements had as great or greater wandering motions. At high supercritical $R_d$ the motion of a smooth sphere reverted to an irregular spiral. Qualitative observations of the motion suggest that the sphere receives a significant momentum impulse every 7 diameters or so of path length. At subcritical $R_d$ successive impulses are in alternate directions, yielding a fairly regular motion with a wavelength of 14 diameters. Impulses at supercritical $R_d$ are randomly orientated with spurious wandering motion. R.N.A.

**N65-35975*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**FLUID QUALITY IN A SELF-PRESSURIZED CONTAINER DISCHARGE LINE**
Hugh M. Campbell, Jr. 18 Aug. 1965 69 p refs
(NASA-TM-X-53330) CFSTI: HC $3.00/MF $0.75 CSCL 20D

The thermal condition of cryogenic fluids in the vertical discharge line during draining of saturated liquid from a self-pressurized container was investigated. At the discharge line inlet the fluid becomes two-phase; however, due to the increased static pressure while flowing downward in the discharge line the vapor subsequently condenses. The per cent of evaporation and the distance required to recondense are dependent upon the type of inlet, rate of discharge, and initial fluid properties. Equations are derived to predict the fluid quality and static pressure in the discharge line. Predictions are made for the maximum fluid quality, the distances required

for vapor condensation, and the vapor variation with elevation. Analytical and experimental results are compared for moderate container pressures and discharge line flowrates. Author

**N65-36004#** Chicago Univ., Ill. Hydrodynamics Lab.
**EXPERIMENTS RELEVANT TO THE INTERPRETATION OF METEOROLOGICAL SATELLITE OBSERVATIONS Final Report, 1 May 1963–31 May 1964**
D. Fultz Jun. 1965 48 p refs
(Contract CwB-WBG-15)
(HL59B65)

CONTENTS:
1. MODES OF INSTABILITY IN SPIRAL FLOW BETWEEN ROTATING CYLINDERS K. W. Schwarz, B. E. Springett, and R. J. Donnelly 11p refs (See N65-36005 24-12)
2. A THREE-DIMENSIONAL VORTEX INSTABILITY IN ROTATING FLUIDS D. Fultz and T. S. Murty 15 p refs (See N65-36006 24-12)

**N65-36005** Chicago Univ., Ill.
**INST. FOR THE STUDY OF METALS AND DEPT. OF PHYSICS. MODES OF INSTABILITY IN SPIRAL FLOW BETWEEN ROTATING CYLINDERS**
K. W. Schwarz, B. E. Springett, and R. J. Donnelly *In its* Expts. Relevant to the Interpretation of Meteorol. Satellite Observations Jun. 1965 12 p refs Repr. from J. Fluid Mech. (Cambridge, England), v. 20, pt. 2, 1964 p 281–289 (See N65-36004 24-12)

The flow between rotating cylinders with a narrow annulus (with the outer cylinder stationary) was observed to have three distinct types of instability, each with a well-defined value of $T$ at which they become self-sustaining: the familiar axisymmetric mode, the first azimuthal mode of the form exp $i(\theta-\omega t)$, and a completely unsymmetric instability apparently dependent on the interaction of the $m = 1$ and axisymmetric modes. The qualitative behavior of these patterns was not affected by small flow-rates up to $R_x = 20$. The effect of $R_x$ on $T_c$ was quantitatively determined for low $R_x$. In the axisymmetric case, the results are in excellent agreement with the theoretical predictions of Krueger & DiPrima. The non-symmetric modes show a similar dependence on $R_x$, although they occur at higher Taylor numbers. Author

**N65-36006** Chicago Univ., Ill. Hydrodynamics Lab.
**A THREE-DIMENSIONAL VORTEX INSTABILITY IN ROTATING FLUIDS**
D. Fultz and T. S. Murty *In its* Expts. Relevant to the Interpretation of Meteorol. Satellite Observations Jun. 1965 18 p refs (See N65-36004 24-12)

The axisymmetric subclass of small oscillations for the case of a right circular cylinder of fluid having a basic rigid rotation about its axis was analyzed. Trial experiments were made with oscillations where there was a substantial radial variation of depth, using a small vertical-axis turntable assembly with shallow and deep containers. The discovery of the (10,0,1) mode instability in the deep paraboloid is described, and preliminary estimates of possible dimensionless critical parameters for the instability are discussed. It was tentatively concluded that the observed oscillatory vortex instability is produced by some essentially inviscid mechanism which is a new type among the problems of hydrodynamic stability. S.C.W.

**N65-36073#** Naval Ordnance Test Station, China Lake, Calif.
**MEASUREMENT OF PARTICLE VELOCITIES IN SUPERSONIC GAS STREAMS**
Richard D. Fulmer and David P. Wirtz Dec. 1964 54 p refs
(NAVWEPS-8505; NOTS-TP-3487; AD-617656)

A photographic technique was developed at the U.S. Naval Ordnance Test Station, China Lake, to directly measure the velocity of particles as small as 2-3μ-diameter traveling at velocities up to 2,600 ft/sec in supersonic gas streams. A double-pulsed explosive-krypton light source was used to provide intense and precisely controlled light pulses that were used both for illuminating and shuttering the event. The particle images were recorded on film as pairs of streaks. The velocities of the particles were determined from the magnification of the camera-lens system, the measured distance between the streaks on the film, and the time interval between flashes. A series of ten runs was made in which the velocity of 3-50μ particles were measured as they were carried in a 2,900 ft/sec helium stream. Particle velocities up to 2,600 ft/sec were measured with an accuracy of from 1.5 to 3.2%. By optimizing the technique it should be possible to extend the measurements to higher particle velocities. Author

**N65-36150#** Ohio State Univ. Research Foundation, Columbus.
**FORMATION OF DETONATION WAVES IN FLOWING COMBUSTIBLE GASEOUS MIXTURES Final Report, 1 Dec. 1962–31 Jan. 1965**
Loren E. Bollinger, Gary C. Smith, Frederick J. Tomazic, and Rudolph Edse 22 Apr. 1965 10 p refs *Its* Rept.-1574
(Grant AF-AFOSR-203-63)
(AFOSR-65-1051; AD-618200)

Detonation induction distances were measured in hydrogen and methane–oxygen mixtures flowing at various velocities through a stainless steel tube, 9 mm inside diam. The linear flow velocities of the gas mixture ranged from 0–100 m/sec in hydrogen–oxygen mixtures. Some experiments were conducted at 5 atm initial pressure. Experiments with methane–oxygen mixtures were carried out at 1 atm only; the initial velocities of these mixtures ranged from 0–30 m/sec. It was found that the formation of detonation waves in flowing combustible gaseous mixtures is dependent upon the initial pressure and the intensity of turbulence present in the gases. As the initial pressure is raised, the effect of turbulence becomes less pronounced. Higher turbulence levels cause an effective decrease in the quenching diam as indicated in these experiments. Higher flow rates for a methane–oxygen mixture (50 per cent fuel) insure positive ignition and positive measurement of flame propagation rates. TAB

**N65-36178#** Wisconsin Univ., Madison. Mathematics Research Center.
**NUMERICAL SOLUTION OF THE NAVIER–STOKES EQUATIONS FOR THE FLOW IN A CHANNEL WITH A STEP**
Mitutosi Kawaguti May 1965 34 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-574; AD-620108)

The steady flow of a viscous fluid in a channel with a forward facing or a backward facing step is studied numerically. It is assumed that the channel is bounded by rigid walls, and the flow in the channel far from the step is the Poiseuille flow. It is shown that the length of a standing vortex behind a backward facing step increases roughly proportionally to the Reynolds number ($R \leq 64$). The pressure loss due to a forward facing step increases with the Reynolds number, on the other hand, due to a backward facing step, it decreases with the Reynolds number. Author

**N65-36187#** Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
**TECHNIQUES FOR SOLVING NONEQUILIBRIUM EXPANDING FLOW PROBLEMS Interim Report**
Robert E. Mates and John A. Lordi Wright-Patterson AFB, Ohio. ARL, Jan. 1965 38 p refs
(Contract AF 33(657)-8860)
(ARL-65-2; AD-614457)

Methods of solving the problem of expanding nonequilibrium flows have been under development for some time. The extension of the calculations to higher temperatures and pressures has necessitated improvements in the calculation methods. This report summarizes those techniques which have not been previously discussed and includes the recent modifications. The solution of nonequilibrium nozzle flows involves the numerical integration of a set of nonlinear ordinary differential equations. Difficulties are encountered in starting the solution since the flow is initially in equilibrium. The starting technique is based on a perturbation about the equilibrium solution. Several possible perturbation methods are discussed and compared. A method is presented for mixing the equilibrium and nonequilibrium equations which is useful for systems involving widely different reaction rates. Improvements in the numerical integration technique, including the Runge–Kutta method, are discussed. These improvements reduce oscillations in the solution and reduce computing time. It is shown that substantial reductions in computing time are made possible by starting the solution as far downstream as possible. The solutions obtained do not depend on the starting point. Author

**N65-36217#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**EXPERIMENTAL INVESTIGATION OF MICROWAVE SCATTERING FROM THE SUBSONIC FLOW FIELD PRODUCED BY AN ARC JET**
Richard C. Jenkins and Gerard T. Connell Feb. 1965 32 p refs
(RM-267)

The study reported herein was undertaken to determine the feasibility of using the arc jet for an investigation of microwave scattering from a turbulent, ionized gas flow. The primary purpose of this investigation was to obtain information which would be useful in the analysis of radar returns from high altitude turbulent wakes. In regions of the flow where an uncooled probe could be used, measurements were taken of axial and radial variations in stagnation temperature and pressure. Shadowgraphs were taken through various portions of the flow to examine local turbulent density fluctuation. With either K-band or X-band fields incident broadside on the flow, microwave receiving horns were placed at various locations around the jet to examine fluctuations in the scattered microwave field patterns. During the course of this experimental work a number of difficulties were encountered or were anticipated which indicate that considerable effort would have to be expended in the development of experimental microwave techniques before measurements of any value could be obtained. At the same time it became apparent that the use of the arc jet for this type of work was questionable because of the small flow field size compared to the microwave wavelength. This report presents an account of work done during the feasibility study and the results which led to termination of the project. Author

**N65-36220#** Joint Publications Research Service, Washington, D. C.
**TRANSVERSE DIFFUSION DURING WAVE DIFFRACTION ON A WEDGE**
P. Ya. Ufimtsev 13 Oct. 1965 14 p refs Transl. into ENGLISH from *Radiotekhn. i Elektron. (Moscow)*, v. 10, no. 6, 1965 p 1013–1022
(JPRS-32373; TT-65-32863) CFSTI: $1.00

An asymptotic solution for the problem of diffraction of a plane wave on an ideally reflecting wedge is given. This solution is obtained through the use of the parabolic equation written in radial (polar) coordinates. It is shown that the solution obtained when $\kappa\pi >> 1$ practically coincides with the proximate Zommerfeld solution. The results obtained are generalized to the case of diffraction of a cylindrical wave. Author

**N65-36321#** Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
**FORCE CHARACTERISTICS OF RESTRAINED, NATURALLY VENTILATED HYDROFOILS IN REGULAR WAVES**
J. M. Wetzel and K. E. Foerster Mar. 1965 47 p refs
(Contract Nonr-710(47))
(Rept.-68; AD-620352)

Experimental data were obtained for the steady force characteristics of naturally ventilated hydrofoils of finite span with trailing edge flaps. The foils were submerged below a free surface. The data were compared with theory corrected for effects of finite span. Investigations were also made of the oscillatory lift and drag forces for restrained, naturally ventilated foils of finite span moving through regular head and following seas. The experimental data for the amplitude of the oscillatory forces were essentially independent of the reduced frequency, based on chord, up to about 1.1. Cavity wash-off due to wave-induced changes in the angle of attack was also investigated. Author

**N65-36323#** Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
**SELF-SIMILAR HYDRODYNAMICS WITH VORTEX SHEETS**
Richard Coval Alexander Jun. 1965 128 p refs
(Contract AF 49(638)-496)
(AFOSR-SR-65-0642; AD-620323)

A discussion is given of asymptotic solutions with vortex sheets in the shape of logarithmic spirals in which possible total solutions are indicated to a number of problems with given initial conditions. The method by which these solutions are obtained serves to illustrate the semi-inverse approach as it might be applied to a more general class of spiral regions. An essential feature of the semi-inverse method is that there be a known conformal map with which to simplify the analysis. The nature of such a map is determined for $C_1 \neq 0$, and two examples are given for $\nu = 1/2$: one with $N = 1$ for application to problems with a single wedge, and the other with $N = 2$ for application to the self-similar jet problem, or to a problem with two wedges symmetrically arranged in liquid as they move apart in opposite directions. Author

**N65-36324#** Johns Hopkins Univ., Baltimore, Md. Dept. of Mechanics.
**THE HALL EFFECT IN THE TWO-DIMENSIONAL FLOW ALONG AN INSULATING PLANE**
H. Hasimoto and G. S. Janowitz Jun. 1965 33 p refs
(Contract AF 49(638)-496)
(AFOSR-65-1201; AD-620324)

Two-dimensional flow of a conducting gas interacting weakly with an external inhomogeneous magnetic field is considered. It is proved that for flow over an insulating wall, the total drag force is reduced by the Hall effect, and the total transverse force is zero. General expressions for the Hall current and the induced transversal flow are obtained for the case of flow with small Hall parameter over an infinite insulating plane. Examples are given for the dipole magnetic field. An inversion of the transversal flow, varying with the dipole orientation, is found. This situation also suggests a transversal deflection of the flow behind a magnetized body in the flow of a plasma. Author

N65-36345# Harry Diamond Labs., Washington, D. C.
**SOME TOPICS IN FLUID CIRCUIT THEORY, PAPER A1**
Joseph M. Kirshner [1965] 12 p refs Presented at 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8-9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

Progress in fluid circuit theory is reviewed for situations where the fundamental equations can be linearized, the momentum is negligible, and where the turbulence is neglected. Transmission line equations are formed by treating the line as a four pole that can be terminated as desired. Knowing the series impedance and the shunt admittance makes it possible to find the effect of an arbitrary load, and to determine the velocity distribution within the duct from the momentum equation and the boundary conditions. For low frequencies the series impedance is almost entirely resistive, and the velocity distribution approximates the Hagen-Poiseuille distribution for fully developed flow. These processes can be applied to lumped circuit elements and branching networks. A bibliography of 26 papers on fluid circuit theory is included. G.G.

N65-36383# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
**TURBULENT SKIN FRICTION AND HEAT TRANSFER IN TWO- AND THREE-DIMENSIONAL FLOWS [FROTTEMENT ET TRANSFERT DE CHALEUR TURBULENTS EN ECOULEMENTS BI- ET TRI-DIMENSIONNEL]**
Roger Michel and Ngo Duc-Lam 1965 30 p refs In FRENCH; ENGLISH summary
(ONERA-TN-80(1965)) CFSTI: HC $2.00/MF $0.50

The results relative to various turbulent boundary layer problems obtained from the solutions of the boundary layer integral equations are considered. A theoretical approximation, based on flat-plate expressions of the skin friction and heat transfer coefficients as functions of Reynolds numbers relative to the boundary layer thicknesses, is applied to three important examples: (1) turbulent heat transfer on the blunt nose of a missile; (2) skin friction on delta wings at incidence; and (3) turbulent heat transfer on the yawed infinite cylinder. A more accurate theoretical treatment leads to a reconsideration of the effects of strong negative pressure gradients on the factor of analogy between turbulent skin friction and heat transfer. Author

N65-36400# International Business Machines Corp., Zurich (Switzerland). Zurich Research Lab.
**BASIC PROPERTIES OF FLUID MECHANIC ELEMENTS, PAPER A2**
H. H. Glaettli [1965] 6 p refs Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8-9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

It is shown that elementary expressions based on simple assumptions can be used to evaluate important properties of pure fluid devices. Such properties are operating pressure, operating power, and response time. Only a very few constants enter the picture; they vary simply over a limited range and can easily be determined experimentally. Elimination of the average flow velocity by introducing the Reynolds number shows immediately that minimum operating pressure and minimum operating power increase with decreasing size. The same is true for the minimum response time. The maximum values of operating power and response time decrease with decreasing size. The reason is that there exists, in addition to the requirement of a minimum Reynolds number, another limitation: a maximum operating pressure which is independent of size. A minimum size is determined by the crossover of minimum and maximum operating power. A lower limit for the response time can be estimated by considering the free jet amplifier as an idealized model for pure fluid amplification. This allows comparison of different designs or different types of amplifiers by their figures of merit. Such a figure of merit states how far behind the ideal behavior an actual amplifier is, and can be applied independent of the geometry involved. Author

N65-36403# National Gas Turbine Establishment, Pyestock, (England).
**THE FLUID OSCILLATOR AS A TEMPERATURE SENSOR, PAPER D1**
D. Reeves, M. E. Inglis, and L. Airey [1965] 16 p refs Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8-9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

A description of the principles and operation of fluid switches and oscillators is given, with indications of possible practical applications to temperature measurement. This is followed by an account and discussion of the experimental work with one design of oscillator to determine the effect on operating frequency of such physical variables as feed-back length, pressure, and temperature. Some ancillary work was included to investigate the switching mechanism and its relationship to the shape of acoustic waves propagated through the feed-back pipes. The conclusion is reached that, while the oscillation frequency shows the predicted variation with temperature, more work will be needed to understand and eliminate both random and systematic errors experienced. Heat transfer problems, intrinsic to the acoustic oscillator tested, may limit the rapidity of transient response and it will be necessary to look into alternative designs before a practical temperature sensor can be realized. Author

N65-36404# International Business Machines Corp., Zurich (Switzerland).
**CIRCUITS USING FLUID DYNAMIC COMPONENTS, PAPER D4**
H. H. Glaettli [1965] 11 p refs Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8-9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

Two circuits, a binary full adder and a binary counter, are described. The adder unit can be used as a serial adder or in a parallel adder. The counter unit may be cascaded directly. Test procedures for both circuits are explained. A four stage adder is connected as an oscillator, in order to determine the minimum carry propagation time per stage required for sufficient amplification to maintain the signal level. In the case of a multistage counter, it is important to distinguish between the minimum resolving time for counting and the maximum speed for frequency dividing. A test arrangement to determine both capabilities is described, and test results including typical pressure diagrams are given for geometrically similar elements of various sizes. It is shown that geometric similarity and constant Reynolds number are not sufficient to maintain mechanical similarity when Mach numbers higher than .1 to .3 or cavitation effects are involved: The Mach number, for instance, increases automatically when the size of the element operated at constant Reynolds number and with the same gas, is decreased. Author

N65-36406# Birmingham Univ. (England).
**THE TURBULENT REATTACHMENT AMPLIFIER IN A CONVENTIONAL PNEUMATIC CIRCUIT, PAPER F1**
K. Foster and A. K. Misra [1965] 14 p ref Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8-9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

This paper describes a timed sequence control consisting of a pure fluid oscillator driving the pneumatic equivalent of an electrical uni-selector and two cylinders operated by piston valves for which the pilot stages are pure fluid turbulent reattachment flip-flops. The timing of the operation of the cylinders may be varied absolutely by changing the frequency of the oscillator or relatively by choosing any appropriate one of the 50 signal points on the pneumatic selector. The response time of a piston valve operated by a fluid element is examined in detail and it is found to be somewhat longer than that given by a solenoid operated pilot valve. However, the simplicity of the fluid element pilot stage is attractive and it is shown that by careful optimisation the speed of response of this could be improved. Author

**N65-36407#** Maxam Power, Ltd., London (England).
**TURBULENCE AMPLIFIERS: PRINCIPLES AND APPLICATIONS, PAPER F2**
J. Hodge and J. G. Hutchinson [1965] 14 p Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

The paper discusses some of the reasons why the introduction of a no-moving-part fluid logic system is desirable at this time, especially in connection with low cost automation using conventional pneumatic valves and cylinders. It describes the reasons which led to the use of the turbulence amplifier from the very large variety of possible devices available and the principles of operation of the basic turbulence amplifier and some simple variants. After describing the means whereby the basic logic functions can be carried out using turbulence amplifiers, several typical simple practical circuits are illustrated. Author

**N65-36409#** Technische Hochschule Stuttgart (West Germany).
**FLUID DEVICES FOR MACHINE CONTROLS, PAPER G2**
H. J. Wiesner and M. A. Rüdle [1965] 7 p Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

The problem presented above shows, that it is possible to establish controls for machine-tools exclusively with pneumatic means. If this is accomplished with conventional pneumatic devices however, there are no advantages to the existing control-systems based on electric or electronic means. However, if pure fluid devices are used simple controls can be established economically. They are as reliable as electronic controls, fast enough for these applications and the costs of production are lower. Author

**N65-36422#** Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro. Instituto de Matematica Pura e Aplicada.
**ON THE DENJOY-CARLEMAN THEOREM FOR THE INDEFINITE DIFFERENTIABLE QUASI-ANALYTICAL VECTORIAL APPLICATIONS [SUR LE THEOREME DE DENJOY-CARLEMAN POUR LES APPLICATIONS VECTORIELLES INDEFINIMENT DIFFERENTIABLES QUASI-ANALYTIQUES]**
Leopoldo Nachbin 1964 6 p refs In FRENCH Submitted for Publication *Its* Notas de Fisica, Vol. 11, No. 10 CFSTI: HC $1.00/MF $0.50

Sufficient conditions are given for an indefinite differentiable application of a vectorial variable with vectorial values which are quasi-analytic. Successive differential equations with m-seminorms are used. Transl. by J.O.

**N65-36453#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**THE EFFECTS OF DISTRIBUTED GAS BUBBLES ON A LIQUID FLAT PLATE BOUNDARY LAYER**
Subba Rao Gutti and V. Michael Pick Mar. 1965 37 p refs (RE-203J)

This report discusses a laminar boundary layer on a flat plate in a liquid containing a dilute suspension of gas bubbles. A mathematical model is formulated for the flow of gas bubbles in a viscous liquid, and expressions for the characteristic time and characteristic length associated with the motion of a single gas bubble relative to the the liquid are derived. Navier-Stokes equations are modified to include the effect of the gas on density and the non-Newtonian viscosity effects that result from the bubble slip and finite bubble size in a continuous model. The unsteady effects of bubble motion are included as an apparent mass. The boundary layer equations for the case of no gravitational effect are reduced to ordinary differential equations by utilizing the first terms of a series expansion in the characteristic length of the gas bubble motion. These equations have been solved numerically using a Runge-Kutta integration program. Author

**N65-36470** Bettis Atomic Power Lab., Pittsburgh, Pa
**PRELIMINARY AIR-WATER MIXING TESTS**
P. L. Pfennigwerth and R. W. Steer Aug. 1965 26 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-492) CFSTI: $2.00

Eddy diffusivity has been measured for mixing in the wide direction of a 3.0 × 0.100-inch vertical duct with upflow, using a dye tracer in water and a helium tracer in air. Diffusion-type equations based upon a point source were used to analyze the data. Experimental techniques were investigated, and the method using the lateral profile of tracer concentration was found to be most satisfactory. An empirical correlation was obtained between Reynolds Number (V De/$\nu$) and the dimensionless mixing number (E/V De). Author

**N65-36475#** Argonne National Lab., Ill.
**STATISTICAL ANALYSIS OF THE LOCAL STRUCTURE OF TWO-PHASE FLOW. II: CHANGE OF CONFIGURATION AND DISTRIBUTION WITH THE OCCURRENCE OF BUBBLES**
C. Lackme [1965] 16 p refs Transl. into ENGLISH of Note TT No. 176 "Analyse Statistique de la Structure Locale d'un Ecoulement Diphase. II: Changement de Configuration et Distribution des Arrivées de Bulles" Grenoble, Center of Nucl. Studies, Oct. 1964 p 1–18
(ANL-TRANS-172)

Both the air flow, G, and water flow, L, were varied systematically. It is shown that the Erlang distribution factor, k, for the occurrence of bubbles at a point in the channel is characteristic of the flow structure. When k = 1, it corresponds to individual bubbles in the liquid, when k = ∞, it corresponds to slug flow whose periodicity has been noticed by many other authors. Between these two extremes, the value k = 2 is observed for a relatively long time during the transition which precedes the appearance of the slug flow and extends through a small region of the flow. The study of the average time interval between bubbles shows that they tend to be expelled from the axis of the channel when the water flow increases at constant air flow. The description of the variation of the distance between bubbles, d, as a function of flow L and G results in the axis of the channel of relaxation of the form: $d = (f(L)/G^{3/2})$ Author (NSA)

**N65-36483#** McGill Univ., Montreal (Quebec). Gasdynamics Research Lab.

**AN INVESTIGATION OF CYLINDRICAL DETONATION WAVES**

Benedict H. K. Lee Mar. 1964 100 p refs
(Grant NRC G-1255)
(MERL-TN-64-3 (GD-21)

The dynamics of the combustion products behind a cylindrical detonation wave is analyzed by extending the Taylor-Zeldovich model of the spherical case. Based on the conservation of mass, it is shown that when the reaction zone thickness is not small compared to the radius, a steady detonation wave cannot exist. A study of the initiation mechanisms of a cylindrical detonation wave shows that it must be initially over-driven and for a large radius, the Chapman-Jouguet hypothesis is satisfied. In addition, ionization probes are used to determine the detonation velocities in acetylene–oxygen mixtures with different chemical compositions (20% to 60% acetylene by volume). Pressure measurements of the combustion products were compared with theoretical values based on the similarity solution. The phenomena of spinning and pulsations, and the problem of transition from cylindrical deflagration to detonation are also investigated. L.S.

**N65-36491#** Florida Univ., Gainesville. Florida Engineering and Industrial Experiment Station.

**WAVE ATTENUATION IN A CHANNEL WITH ROUGHENED SIDES Technical Paper No. 323**

A. Battjes Jul. 1965 37 p refs *Its* Eng. Progress at the Univ. of Florida Vol. 19, No. 7
(Grant NSF G-19939)

A semiempirical study was made of the attenuation of water waves in a rectangular channel, the side walls of which had been provided with regularly spaced roughness strips. Such strips were found to be highly effective wave dampers. A dimensionless resistance coefficient could be deduced from the attenuation data; this coefficient was mainly a function of the ratio of horizontal orbit diameter to roughness height. The roughness strips, when compared to wave dampers using the resonance principle, appear to cover a greater portion of the frequency spectrum. The processes by which energy is transferred laterally to the side walls were investigated. These investigations fell short of their aim, however, mainly due to the disturbing effects of lateral secondary waves. Author

**N65-36497#** California Univ., Livermore. Lawrence Radiation Lab.

**A NUMERICAL CALCULATION OF TWO-DIMENSIONAL STEADY-STATE DETONATIONS BY THE METHOD OF CHARACTERISTICS**

Gerald T. Richards 26 May 1965 7 p refs
(Contract W-7405-ENG-48)
(UCRL-14228) CFSTI: $4.00

This paper presents a method for finding the state of the detonation products for a plane detonation wave utilizing the two-dimensional steady-state hydrodynamics equations and the method of characteristics. It is shown that in those cases where the equation of state gives pressure along the adiabat as a function of density (only), the characteristic equations can be solved analytically in velocity space for the plane problem. A numerical method for the solution in coordinate space is then developed using the solution in velocity space in conjunction with the geometric relationship between characteristic curves in the two spaces. In this manner the difficulty encountered due to the coincidence of the detonation front and two characteristic curves in coordinate space is overcome. The derivations involved are included as appendices. The body of the paper describes the application of the technique for an ideal gas equation of state. A further application is described in which this solution is used to start a solution for a steady state detonation in cylindrical geometry. Author

**N65-36518#** Los Alamos Scientific Lab., N. Mex.

**LAMINAR INCOMPRESSIBLE FLOW IN CHANNELS WITH POROUS WALLS, APPENDIX C**

B. K. Knight, Jr. and B. B. Mc Inteer [1956] 23 p refs
(Contract W-7405-ENG-36)
(LA-DC-5309)

Solutions are presented to the problem of steady two-dimensional flow through a channel bounded by porous walls which supply or remove an incompressible fluid with a uniform normal velocity. The task of solving the problem is reduced to the integration of a single differential equation. A solution, satisfying all boundary conditions, is found for the case of vanishing viscosity. When the wall is a fluid source, the finite viscosity solutions converge uniformly to that for zero viscosity. However, when the wall is a fluid sink the finite viscosity solutions converge nonuniformly to a flow involving wall slippage in the typical boundary layer fashion. The zero viscosity solution furnishes the basis of a perturbation method which yields precise results in the case where the wall is a source. However, when the wall is a sink the same method yields completely erroneous results. For small viscosity the perturbation solutions satisfy the exact equations to an arbitrary degree of accuracy, but there is no nearby exact solution. This is a striking counter example to heuristic justification of perturbation methods in general. R.N.A.

**N65-36575#** Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Applied Mathematics.

**THE NUMERICAL INTEGRATION OF THE EQUATIONS OF MOTION OF A VISCOUS FLUID Scientific Report No. 1**

J. Gillis and A. Brandt 1 Oct. 1964 59 p refs
(Grant AF-EOAR-63-73)
(AFOSR-65-0629; AD-614915) CFSTI: HC $3.00/MF $0.75

The purpose of this report is to describe methods which have been developed for the numerical solution of the Navier-Stokes equations. Work has been concentrated so far on the problem of the steady state two-dimensional flow of a homogeneous incompressible viscous fluid in the inlet region of a straight channel. The methods used have been successful for values of the Reynolds number ranging from 0 to 500, i.e., well into the range where one may allow boundary layer methods to take over. In this latter range the solutions for different values of R are all related by elementary similarity conditions. Author

**N65-36577#** Oklahoma Univ., Norman.

**A STUDY OF OROGRAPHICALLY DISTURBED FLOW**

George P. P. Emodi (M.S. Thesis) 1965 49 p refs
(AD-620388)

The Reynolds number range associated with the formation of lee wave vortices was studied in laboratory experiments with fluid flow around symmetrical objects. No regular vortex pattern in the wake of the object is to be expected unless the Reynolds number is below $5 \times 10^5$; above that number turbulence develops in the boundary layer. Yet in the atmosphere the value of the Reynolds number is on the order of $10^{10}$, so that the observation of vortices in the atmosphere is apparently paradoxical. This discrepancy can be eliminated if the definition of Reynolds number is modified by using the kinematic coefficient of eddy viscosity in place of the kinematic coefficient of molecular viscosity. This study also indicates

that formation of vortices in a horizontal plane is not very likely when an air stream crosses an infinitely long barrier. J.M.D.

**N65-36580#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**A STUDY OF THE DEVELOPMENT OF STEADY SEPARATED FLOWS. PART I: LINEARIZED ANALYSIS OF CIRCULAR EDDIES**
Odus Burggraf 26 Jun. 1964 35 p refs
(LMSC-6-74-64-34; AD-620332)

The viscous structure of a separated eddy is investigated for the case of a simplified geometry. An analytical solution is obtained for an eddy bounded by a circular streamline, based on a linearized model. This solution shows in a simple manner the development from a completely viscous eddy at low Reynolds number, in the manner envisaged by Batchelor. Quantitatively, the solution shows that a significant inviscid core exists for Reynolds number greater than 100. At low Reynolds number the vortex center shifts in the direction of the boundary velocity until the inviscid core develops; at large Reynolds number, the inviscid vortex core is symmetric about the center of the circle, except for the effect of the boundary-layer displacement-thickness. Special results are obtained for velocity profiles, skin-friction distribution, and total power dissipation in the eddy. In addition, results of the method of inner and outer expansions are compared with the complete solution, indicating that expansions of this type give valid results for separated eddies at Reynolds numbers greater than about 25 to 50. The validity of the linear analysis as a description of separated eddies is confirmed to a surprising degree by numerical solutions of the full Navier-Stokes equations for an eddy in a square cavity. These solutions were carried out by relaxation procedure on a high-speed digital computer. Author

**N65-36621#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**THE CALCULATION OF COMPRESSIBLE, FRICTIONLESS SUBSONIC FLOW THROUGH SPATIAL GRIDS OF VERY THICK BLADES WITH PRONOUNCED CURVATURE [DIE BERECHNUNG DER KOMPRESSIBLEN, REIBUNGSFREIEN UNTERSCHALLSTROMUNG DURCH RAUMLICHE GITTER AUS SCHAUFELN AUCH GROSSER DICKE UND STARKER WOLBUNG]**
Hans Ernst Jmbach (Ph.D. Thesis) Juris-Verlag, 1964 143 p refs In GERMAN
(PROM.-3402) CFSTI: HC $4.00/MF $0.75

Described is an anaytical procedure to determine the compressible potential air flow through conical formed cascades. This was done by superimposition of the velocity fields of the vortexes acting on the blade profiles, and of the eddies and depressions around the profiles, over the established basic air flow. This method was also applied to find the three-dimensional cascade flow between two coaxial boundaries. Calculation results showed good agreement with established values. G.G.

**N65-36622#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**THE BEHAVIOR OF FALLING DROPS [DAS VERHALTEN FALLENDER TROPFEN]**
Anton Reinhart (Ph.D. Thesis) Juris-Verlag, 1964 74 p refs In GERMAN
(PROM.-3412) CFSTI: HC $3.00/MF $0.75

The stationary falling velocities of 20 different liquid drops through air of varying densities were studied by analytic and photographic methods. Results established the falling resistance coefficient as a function of the Reynolds number, and the dimensionless velocity as a function of the dimensionless diameter of the drop. It was found that the stationary velocity was completely independent from the viscosity of the used liquid; interior flow circulation did not influence the falling velocity. Measurements of the photographed droplet deformations established a correlation between the relative deformation, the droplet diameter, and the overall drop dimensions. G.G.

**N65-36623#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**ON EQUILIBRIUM AND FLOW CONDITIONS OF GAS ABSORPTION UNDER INCREASED PRESSURE [UBER DIE GLEICHGEWICHTS- UND STROMUNGSZUSTANDE BEI DER ADSORPTION VON GASEN UNTER ERHOHTEM DRUCK]**
Hans-Veli Bürki (Ph.D. Thesis) Schmidberger und Müller, 1964 109 p refs In GERMAN
(PROM.-3512) CFSTI: HC $4.00/MF $0.75

An universal adsorption isotherm was formulated and used to predict any adsorbed pure gas volume on active carbon under varying pressures and temperatures. Adsorption equilibrium curves of various binary and ternary hydrocarbon mixtures were related to applied pressures; increased pressures resulted in insufficient separation of the hydrocarbon mixtures and poor adsorption. Studies of gas flow conditions in more or less porous coals showed that the pressure drop can be predicted by evaluation of the gas particle surface factor, and the particle diameter. Transl. by G.G.

**N65-36660#** New York Univ., N. Y.
**A FINITE DIFFERENCES SOLUTION FOR AN INITIAL VALUE PROBLEM IN A COMPRESSIBLE LAMINAR BOUNDARY LAYER Interim Technical Report**
Gdalia Kleinstein Wright-Patterson AFB, Ohio, ARL, May 1965 40 p refs
(Contract AF 33(615)-1516)
(ARL-65-107; AD-619057)

A finite differences solution is presented for an initial value problem in an inhomogeneous compressible laminary boundary layer. The method is to be employed in the determination of velocity, temperature, and concentration profiles in the boundary layer; and heat transfer and shear distributions on the wall. The program is designed to accommodate either constant or variable transport properties. Diffusion coefficients used correspond to a binary mixture and consequently applications to inhomogeneous cases are restricted to either an arbitrary binary mixture or to a multicomponent mixture the constituents of which have similar diffusion properties. Author

**N65-36665#** Sperry Rand Corp., St. Paul, Minn. UNIVAC Div.
**FLUID AMPLIFICATION. 12: BINARY COUNTER DESIGN Final Report**
T. A. Shook, T. F. Chen, and T. D. Reader Washington, Harry Diamond Labs., 30 Nov. 1964 173 p refs
(Contract DA-49-186-AMC-34(X))
(AD-617699)

The following report is a detailed account of the work carried out to develop analytical tools which indicate circuit values in the construction of an all-fluid system, and which then predict its operating characteristics. In short, a circuit theory is to be formulated. An n-stage binary counter is selected for analysis, the foundations of which are the analogous equations of fluid flow and electrical current, and empirically formulated element characteristics. Author

**N65-36680#** Centre National de la Recherche Scientifique, Meudon (France). Laboratoire d'Aerothermique.
**STUDY OF THE DISSIPATIVE REGIONS AND OF WAKES IN RAREFIED ATMOSPHERE [ETUDE DES ZONES DE DECOLLEMENT ET DES SILLAGES EN ATMOSPHERE RAREFIEE]**
Pierre Trepaud May 1965 79 p refs In FRENCH *Its* Publ.-230 (Rept.-65-4) CFSTI: HC $3.00/MF $0.75

The oscillations of a plate and the wake produced by a circular cylinder at relatively small Mach numbers in a rarefied atmosphere were studied. Experimental results show that in the case of the plate, the general structure of the flow is comparable to that observed in a continuous system, except for the fact that the same pressure distribution is not present about the surface of the plate. In the case of the cylinder, the experiment indicates that the wake becomes modified as the gas becomes more and more rarefied. Transl. by G.A.L.

**N65-36713#** Alabama Univ. Research Inst., Huntsville.
**INVISCID HIGH TEMPERATURE HYPERSONIC FLOW OF AIR PAST POINTED BODIES OF REVOLUTION Quarterly Interim Technical Report, Jun. 30–Sep. 30, 1964**
Jurgen Thoenes and Rudolf Hermann Oct. 1964 41 p refs
(Contract DA-01-009-AMC-166(Z))
(AD-467786)

To determine the degree of oxygen dissociation behind the attached shock an air model consisting of oxygen atoms, oxygen molecules, and nitrogen molecules was used. The average molecular weight of this model is the same in the undissociated state as in atmospheric air; therefore, the gas constant and density are the same as those of undissociated air. Of the remaining gases in atmospheric air, consisting mainly of argon and carbon dioxide, approximately two thirds were added to the oxygen, and one third to the nitrogen fraction of the gas model. The resulting composition, properties, and other constants used in the calculations are summarized. Dorodnitsyn's method of integral relations was used for solving the system of governing equations. M.C.J.

**N65-36727#** Cornell Univ., Ithaca, N. Y. Sibley School of Mechanical Engineering.
**AN ANALYTIC STUDY OF FILM BEHAVIOR IN HORIZONTAL ANNULAR TWO-PHASE FLOW Interim Report**
R.H. Pletcher and H. W. McManus, Jr. Apr. 1965 89 p refs
(Grant DA-ARO(D)-31-124-G188)
(AROD-3199-1; AD-619308)

The behavior of a thin liquid film originally of annular cross-section was examined insofar as depth and velocity field were concerned when the film was exposed to high shear on the free surface and the action of gravity. The applicable equations were developed from the Navier-Stokes set, and include the terms necessary for cross flow of the fluid. These equations were resolved by formulating the equivalent finite-difference forms and effecting a numerical solution. The film behavior was determined when the surface was subjected to various stimuli, e.g., surface shear a function of film depth, surface cross shear, etc. Solutions were effected for several combinations of liquid flow and surface shear in a horizontal tube two inches in diameter. The results obtained compare favorably with experimental measurements both from a qualitative and quantitative view. The scaling laws, which permit the several solutions presented to be extended to a whole family of flows, are presented and discussed. The techniques of solution developed in this report are believed applicable to a wide variety of free surface flow problems. Author (TAB)

**N65-36785#** Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
**SUPERSONIC FLOW OVER TWO-DIMENSIONAL AND AXIALLY SYMMETRIC BACKWARD FACING STEPS Annual Summary Report No. 2**
Josef Rom Mar. 1964 32 p refs
(Contract AF 61(052)-576)
(TAE-33; TR-2; AD-620159)

The theoretical and experimental investigations on supersonic flow over two-dimensional and axially-symmetric backward facing steps are summarized in the present report. It is shown that in the case of two-dimensional laminar separation the pressure and heat transfer depend on the parameter $\delta/h \approx L/hRe_L^{1/2}$. It is found that in the present tests at $M = 2$, the total heat rate to the separated zone increases above the attached flow case when $L/hRe_L^{1/2} < 0.067$. In the case of turbulent separation, the pressure behind the two-dimensional step is found to increase slightly with increasing Reynolds number. It is shown that when a turbulent mixing coefficient $\bar{C}_t$ is defined, the step pressure can be correlated with the parameter $L/hRe_L^{-3/5}$ which is proportional to $Re_L^{4/5}\ \delta/h$. Experimental results at Mach numbers 2.25 and 3.5 are presented. Pressure distribution behind axially-symmetric backward facing steps is measured at Mach number 2.25 and 3.5. It is shown that in this case the pressure depends on the parameter $\delta/h \approx L/hRe_L^{1/5}$ Author

**N65-36832#** Purdue Research Foundation, Lafayette, Ind. Fluid Mechanics Group.
**PREDICTION METHODS FOR TURBULENT INCOMPRESSIBLE FLOW IN CONICAL DIFFUSERS**
Stanley C. Titcomb and Robert W. Fox Jul. 1965 183 p refs
(Contract DA-31-124-ARO(D)-138)
(FMTR-65-2; AROD-4332-2; AD-619084)

The aim of this study is to provide a method which is capable of predicting the entire mean-velocity field in a conical diffuser when the inlet velocity field is turbulent, incompressible, and completely specified. The desired prediction method is divided into two phases. In the first phase, a method for predicting the growth of the displacement and momentum thicknesses is considered. For the known straight-walled conical configuration, the value of the displacement thickness is sufficient to specify the free-stream velocity at any point along the axis of the diffuser. Therefore, in the second phase, a method for predicting the velocity profile in the boundary layer using the integral parameters and the free-stream velocity is considered. Several prediction methods to forecast the growth of the integral parameters are proposed. The conical diffuser data from the literature is used as a means for evaluating the applicability of the proposed methods. Author (TAB)

**N65-36833#** Rensselaer Polytechnic Inst., Troy, N. Y.
**THE FLOW OF A DISSOCIATING GAS PAST A CONVEX CORNER. PART I: LINEARIZED THEORY**
Thirukurungudi R. Sundaram Wright-Patterson AFB, Ohio, ARL, May 1965 42 p refs
(Contract AF 33(615)-1080)
(ARL-65-106; AD-619278)

The linearized flow of a dissociating gas past a convex corner has been examined by Clarke, who obtained a "first-order" solution on the wall. Clarke compared his "first-order" solution with the numerical claculations of Cleaver and found apparent agreement for flow-deflection angles as high as five degrees. In the present paper, the equations describing the

flow are linearized and combined to give a single partial differential equation for the pressure perturbation. In this equation the chemical relaxation time is defined explicitly, and the arbitrariness in the definition of this parameter in Clarke's analysis is avoided. It is shown that the solutions of this linear equation agree with exact numerical solutions only when the flow-deflection angle is very small. An important conclusion of the present work is that the linear theory for the flow of a dissociating gas, when applied to bodies of variable slope, such as airfoils, is much more severely restricted than previously realized. Author

**N65-36859#** Michigan Univ., Ann Arbor.
**A DIGITAL COMPUTER PROGRAM FOR CONDENSATION IN EXPANDING ONE-COMPONENT FLOWS**
Leonard J. Harding Wright-Patterson AFB, Ohio, ARL, Mar. 1965 83 p
(Contract AF 33(657)-8867)
(ARL-65-58; AD-615902)

This report describes a digital computer program for calculating vapor condensation processes that occur in rapidly expanding flows. The treatment emphasizes the program logic required to satisfy the requirements of the mathematical model. Among the most important of these requirements are the search for the onset of nucleation, in an isentropically expanding flow, and the iteration procedure necessary for the joint solution of the nucleation and growth equations and the diabatic flow equations. The program features flexibility in allowable input conditions, short execution time, and a convenient output format. Author

**N65-36867#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**DETERMINING THE DEGREE OF HETEROGENEITY OF A DC AND AC ARC DISCHARGE**
I. V. Dvornikova and I. M. Nagibina 7 May 1965 19 p refs Transl. into ENGLISH from Opt. i Spektroskopiya (Moscow), v. 4, no. 4, 1958 p 421–429
(FTD-TT-64-1138/1+2; AD-615864)

A method for determining the degree of heterogeneity of an arc discharge is described. Theoretical considerations are given and the experimental measurements on a Fabry-Perot interferometer are compared with the theoretical. It was found that the heterogeneity parameter in a direct current and alternating current arc has a value of 1.5 for chromium and manganese atoms and 1.3 for calcium atoms. Also, it was observed that changes in arc burning conditions of amperage and atomic concentration led to a certain change in the degree of heterogeneity. Further, the discharge cloud for ions was more uniform than for neutral atoms. E.E.B.

**N65-36872#** California Inst. of Tech., Pasadena. Hydrodynamics Lab.
**SOME RECENT DEVELOPMENTS IN PROPELLER THEORY**
T. Yao-tsu Wu Feb. 1965 14 p refs Repr. from Schiffstechnik (Germany), v. 12, no. 60, 1965 p 1–12
(Contract Nonr-220(35))
(E-97.6; AD-615353)

Theoretical concepts of propeller blades are presented. Formulations and discussions are given for linearized lifting surface, moderately and heavily loaded, ducted, unsteady, contra-rotating, vertical-axis, supercavitating, and ventilated propellers. Theories on the lifting-line, and lifting-surface are also considered. L.S.

# 13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

**N65-35779*#** National Aeronautics and Space Administration, Washington, D. C.
**FREE ORGANIC RADICALS IN THE MIGHEI AND NOGOYA METEORITES [RADICAUX LIBRES ORGANIQUES DANS LES METEORITES MIGHEI ET NOGOYA]**
J. Duchesne, J. Depireux, and Cl. Litt Apr. 1965 5 p refs Transl. into ENGLISH from Compt. Rend. (France), v. 259, 1964 p 4776–4778
(NASA-TT-F-9321) CFSTI: HC $1.00/MF $0.50 CSCL 08D

The authors studied electronic paramagnetic resonance signals, linked to the free organic radicals present in the Mighei and Nogoya meteorites. They demonstrate that these meteorites are characterized by a value of $g = 2.002$ which is entirely comparable to that of lignites and coals. The high concentration of paramagnetic centers in the Mighei meteorite, namely, $10^{17}$ per gram of carbonized matter, again proves the validity of the analogy which these authors had proposed previously. A discussion of the width of the observed signals leads to the suggestion, in full agreement with recent results by Schulz and Elofson, that the carbonized chondrites have not been subjected to temperatures above 300–400° C. The generality of the analogy with the behavior of coals is discussed and gives a supplementary proof for the assumption that an extra-terrestrial biogenic activity exists. Author

**N65-35791*#** Consultants and Designers, Inc., Arlington, Va.
**BRINGING TO LIGHT A DIURNAL VARIATION OF THE ENERGY SPECTRUM OF AURORAL X-RAYS [MISE EN EVIDENCE D'UNE VARIATION DIURNE DU SPECTRE D'ENERGIE DES RAYONS X D'ORIGINE AURORALE]**
Axel Bewersdorff, Josette Dion, and Jean-Pierre Legrand 12 Oct. 1965 7 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Aeronomie (Paris), v. 260, 3 May 1965 p 4807–4810
(Contract NAS5-3760)
(NASA-TT-F-9908; ST-AA-10398) CFSTI: HC $1.00/MF $0.50 CSCL 04A

This Note brings forth the results of balloon flights having taken place in Kiruna Sweden during the summers of 1963 and 1964. It is shown that the average energy of auroral X-rays increases between 01 00 and 17 00 hours local time and decreases rapidly after 22 00 hours local time. It would seem that this variation is mainly due to a corresponding variation of the energy of auroral electrons. Author

**N65-35807#** Maryland Univ., College Park. Center for Atmospheric and Space Physics.
**THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF AURORA AND RELATED PHENOMENA Final Report, 7 Mar. 1958–31 Dec. 1962**
Richard T. Bettinger Jun. 1965 46 p refs
(Contract AF 19(604)-3861)
(AFCRL-65-368; AD-616926)

An ultrasensitive microbarograph has been developed for use in an experimental investigation of extraterrestrial

shock waves incident on the lower atmosphere. These instruments have a full scale sensitivity of less than one dyne/$cm^2$ and a frequency range from DC to approximately 10 cycles/sec. High altitude balloon flight tests indicate that these microbarograph perform properly; nevertheless, the experimental program had to be abandoned since the small oscillatory motions of the balloons at floating altitudes cause pressure fluctuation which were orders of magnitudes larger than those associated with the physical phenomenon under investigation. Optical studies of an artificially induced sodium cloud in the upper atmosphere by means of a Fabry-Perot Interferometer were undertaken to determine vertical temperature profiles. This effort was unsuccessful due to insufficient radiation intensity for the detector employed. Author

**N65-35811#** Army Electronics Labs., Fort Monmouth, N. J.
**A STUDY OF IONOSPHERIC IRREGULARITIES AND THEIR RELATION TO LABORATORY-PRODUCED PLASMA VORTICES**
W. H. Bostick (Stevens Inst. of Tech.) and A. Papayoєnou Mar. 1965 65 p refs
(ECOM-2587; AD-616360)

Ionospheric irregularities have been investigated for many years by many researchers using various radio wave techniques. These irregularities are highly localized enhancements or depressions of the ambient electron density of the ionosphere. Laboratory experiments indicate that spinning blobs of plasma, called plasma vortices, may be good analogues to the ionospheric irregularities. These vortices, resulting from turbulent conditions in the rear of the current sheet of a coaxial accelerator, or the explosion from the button gun are found to be stable plasma structures. They are deduced to be elongated along a backround magnetic field and to rotate about an axis parallel to the field lines. Their translational motion is perpendicular to these field lines and does not appear to be slowed by the magnetic field. The circulating motion is maintained by radial electric fields which interact with the background magnetic field to give the proper E × B drift. Measurement of the radial electric field shows that the vortices rotate as rigid bodies. Their angular momentum is constant and their decay is very slow. Author

**N65-35861** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EXPERIMENTAL STUDY OF BREAKING STRESS FIELD IN SANDY GROUND**
G. V. Rykov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 125–134 refs (See N65-35850 24-23)

Quantitative data are presented which were obtained during the analysis of experimental studies of explosive waves in sandy ground. The radials and tangents of the normal pressures were measured as functions of time at various distances from the charge. The initial parameters, characterizing the breaking field, are considered. Conclusions on the total deformations during the explosions are included. C.T.C.

**N65-35883#** Comision Nacional de Investigaciones Espaciales, Buenos Aires (Argentina).
**INTERNATIONAL YEARS OF THE QUIET SUN, VOLUME 1**
1965 115 p refs Proc. of the Regional Symp., Buenos Aires, Aug. 1964
(CNIE-PE-2) CFSTI: HC $4.00/MF $0.75

CONTENTS:

1. RECENT TECHNIQUES IN GEOMAGNETIC MEASUREMENTS J. B. Campbell (Coast and Geodetic Survey) 9p (See N65-35884 24-13)

2. VARIATIONS OF SOLAR ORIGIN IN THE EARTH'S UPPER ATMOSPHERE L. G. Jacchia (Smithsonian Astrophys. Obs.) 22 p refs (See N65-35885 24-13)

3. GEOPHYSICAL EFFECTS OF HIGH ALTITUDE NUCLEAR EXPLOSIONS J. F. Kenney and H. R. Willard (Boeing Sci. Research Labs.) 28 p refs (See N65-35886 24-13)

4. ACCELERATION PROCESSES IN THE SUN FOR HIGH ENERGY PARTICLES S. A. Korff (N. Y. Univ.) 6 p refs (See N65-35887 24-29)

5. ISOBARS, FIREBALLS, AND EXTENSIVE AIR SHOWERS K. Sitte (Max-Planck-Institut für Kernphysik, Heidelberg) 19 p refs (See N65-35888 24-24)

6. PROBLEMS OF STRATOSPHERIC CIRCULATION FOR STUDY IN THE IQSY S. Teweles (Weather Bur.) 24 p refs (See N65-35889 24-13)

**N65-35884** Coast and Geodetic Survey, Washington, D. C.
**RECENT TECHNIQUES IN GEOMAGNETIC MEASUREMENTS**
Joel B. Campbell *In* Comision Nacl. de Invest. Espaciales Intern. Years of the Quiet Sun, Vol. 1 1965 9 p (See N65-35883 24-13) CFSTI: HC $4.00/MF $0.75

The Coast and Geodetic Survey program for providing geomagnetic data is outlined, and developments and techniques contributing to advanced knowledge on the physics of the earth and the space surrounding it are discussed. The observatories are listed, and the instrumental equipment at each facility is described, with emphasis placed on the development and evaluation of an automatic standard magnetic observatory. Other techniques considered significant are the continuous recording magnetographs of the fluxgate type, in which a temperature-compensated magnet system is used rather than coils for biasing fields; a controlled magnetic repeat survey program; an experimental field type nuclear magnetometer; and development of an oceanic magnetic observatory. M.G.J.

**N65-35885** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**VARIATIONS OF SOLAR ORIGIN IN THE EARTH'S UPPER ATMOSPHERE**
Luigi G. Jacchia *In* Comision Nacl. de Invest. Espaciales Intern. Years of the Quiet Sun, Vol. 1 1965 22 p refs (See N65-35883 24-13) CFSTI: HC $4.00/MF $0.75

Basic facts on atmospheric structure and variations above 200 km are reviewed; these data are based mainly on analyses of the drag of artificial satellites, and findings recorded by instrumented vehicles. Atmospheric temperature profiles for three stages of solar activity are plotted, and the concentration of the principal atmospheric constituents as a function of height for three exposures are diagrammed. Variations in densities and temperatures are examined, and day and night density profiles in the upper atmosphere at sunspot maximum and minimum were computed. Day and night exospheric temperatures as a function of solar flux were also calculated. Variations caused by changes in solar EUV radiation are described, with satellite drag data used to derive atmospheric densities and temperatures. Upper atmospheric temperature variations are correlated with geomagnetic activities to determine perturbations, and diurnal and semiannual variations are investigated. Various theories relating to these phenomena are discussed, along with models proposed for obtaining solutions to the problems. M.G.J.

**N65-35886** Boeing Scientific Research Labs., Seattle, Wash.
**GEOPHYSICAL EFFECTS OF HIGH ALTITUDE NUCLEAR EXPLOSIONS**

J. F. Kenney and H. R. Willard *In* Comision Nacl. de Invest. Espaciales Intern. Years of the Quiet Sun, Vol. 1 1965 28 p refs (See N65-35883 24-13) CFSTI: HC $4.00/MF $0.75

Data published on experiments designed to investigate the geophysical phenomena associated with high altitude nuclear explosions are reviewed, and the mechanisms which caused particular disturbances are described. Findings on energy release, and VLF disturbances are discussed. Detailed studies, made of changes in the phase and amplitude recordings of VLF stations showed two types of effect: (1) a prompt effect in which the signal characteristics change quickly, and (2) a delayed effect lasting several minutes or longer. It is suggested that the reason for the prompt effect is due to the neutrons which leave the blast area; in investigating the delayed effect, trapped radiation and its precipitation into the ionosphere are considered, with emphasis placed on the injection distribution. Three magnetic effects are also discussed: instantaneous, delayed (a few seconds), and a general or main disturbance. Disturbances were also observed in the F- and E- regions. Some unexplained phenomena are listed, and recommendations are given for reporting future data. M.G.J.

**N65-35889** Weather Bureau, Washington, D. C.
**PROBLEMS OF STRATOSPHERIC CIRCULATION FOR STUDY IN THE IQSY**
Sidney Teweles *In* Comision Nacl. de Invest. Espaciales Intern. Years of the Quiet Sun, Vol. I 1965 25 p refs (See N65-35883 24-13) CFSTI: HC $4.00/MF $0.75

Our knowledge of the stratosphere has been greatly increased by the continued upward extension of the international rawinsonde network since the IGY, accompanied more recently by the initiation of a rocketsonde network and of satellite measurement of stratospheric parameters. Recent studies show that the stratosphere has its own unique circulation characteristics. At the equator, there is a remarkable 26-month zonal-wind cycle between strong easterly and moderate westerly winds. At higher latitudes, east winds alternate with west winds in an annual cycle. While the stratospheric circulation is generally far more steady than that of the troposphere, the winter westerlies, particularly in the northern hemisphere, are occasionally interrupted by the rapid development of long waves and areas of extreme warming. The transport of mass, heat, ozone, and radionuclides within the stratosphere and into the troposphere has proved to be far more rapid than originally estimated. Most of the transport from stratosphere to troposphere occurs through the tropopause gap in the vicinity of the polar front at middle latitudes. As part of the IQSY effort, a number of special programs have been planned for stratospheric observation and analysis. Improved rawinsonde instrumentation has made feasible the analysis of synoptic charts up to the 10-mb (30 km) level. Ozone measurements by ground-based equipment and by soundings are also being made in unprecedented quantity. Author

**N65-35899#** AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
**THE PROPAGATION OF INFRASONIC WAVES IN AN ISOTHERMAL ATMOSPHERE WITH CONSTANT WINDS Scientific Report No. 3**
Allan D. Pierce 1 Jul. 1965 48 p refs
(Contract AF 19(628)-3891)
(RAD-TR-65-21; AFCRL-65-492; AD-618930)

A dispersion relation for low frequency disturbances in an isothermal atmosphere with constant horizontal winds is derived which related the three components of the wave propagation vector $\vec{k}$ to the angular frequency $\omega$ and which depends on the sound speed, the wind velocity $\vec{v}$, and the acceleration of gravity g. The relation is obtainable from that for propagation in an isothermal atmosphere without winds if $\omega$ is replaced by $\omega - \vec{k} \cdot \vec{v}$. The topology of the propagation surface in $\vec{k}$ space is examined and it is found that various modes of propagation are possible. The criteria for a given mode existing for given wind speed and frequency are derived and the group velocity of each type of mode is studied. The theory predicts the existence of two wind modes which, at sufficiently high frequencies, have group velocities nearly identical to the wind velocity. Phase velocities of the wind modes also tend to equal the wind velocity. In the latter portion of the paper, the trajectories of fluid particles are studied for each type of wave propagation mode. Author

**N65-35948#** Oklahoma Univ., Norman. Graduate Coll.
**A COMPARISON OF TECHNIQUES FOR THE SYNTHESIS OF 25 MILLIBAR HEIGHT AND TEMPERATURE FROM KNOWN DATA AT 100 MILLIBARS**
Phillip W. Goertz (M.S. Thesis) 1965 67 p refs
(AD-618695)

Four approaches were taken toward devising means for synthesizing information on wind and temperature profiles at the altitudes of supersonic aircraft. Approach 1 assumes that 24 km is an isopycnic level. Computer programs were written in Fortran for the solution, by quadrant and cubic methods and with the 1410 computer, of the equation for the temperature gradient and the resultant height and temperature from the temperature gradient. Approach 2 assumes isothermalcy between the 100 and 25-mb surfaces; a Fortran program is given for obtaining the 25-mb height and temperature data. Appraoch 3 was statistical with climatological development of a vertical temperature gradient and led to a computer program and a refinement in approach 4. Approach 4 led to a program that corrected the 25 mb computer temperature (from a constant linear temperature gradient) by a regression equation and used the corrected temperature for obtaining a new linear temperature gradient for computing the 25-mb height. TAB

**N65-35978*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**WINDS IN THE 70–200 KM HEIGHT RANGE**
R. G. Roper Sep. 1965 37 p refs
(NASA-TM-X-55296; X-620-65-370) CFSTI: HC $2.00/MF $0.50 CSCL 04A

A general discussion of the upper atmosphere winds in the 70 to 200 km range is presented. Such methods of measurement as radio meteor trails, observations, and sodium vapor trails are also discussed. Sources for obtaining additional information are given, and areas where emphasis should be placed are cited. Atmospheric turbulence in the meteor region, and a qualitative comparison of vapor trail time series releases, and meteor winds over the height range 80 to 100 km are included. Such topics as mean flow, deviations from the mean, the meteor as optical and radio tracers, trail and height shears, and vertical motions are briefly considered. C.T.C.

**N65-35982*#** Consultants and Designers, Inc., Arlington, Va.
**IONOSPHERIC DISTURBANCES WITH SUDDEN COMMENCEMENT AND THE TYPE-IV CHROMOSPHERIC EMISSIONS [LES PERTURBATIONS IONOSPHERIQUES A DEBUT BRUSQUE ET LES EMISSIONS CHROMOSPHERIQUES (TYPE IV)]**

Fernand Carbenay 19 Oct. 1965 5 p refs Transl. into ENGLISH from C. R. Acad. Sci. Ionosphere (Paris), v. 260, 3 May 1965 p 4805–4806
(Contract NAS5-3760)
(NASA-TT-F-9910; ST-AI-SP-10402) CFSTI: HC $1.00/MF $0.50 CSCL 04A

The relationship between the type-IV chromospheric emissions and the sudden ionospheric disturbances is studied on the basis of the results of observations for the years 1956–1960. It is concluded that in most of the cases type-IV emissions are attended by IDSC if the stations where recordings are made or of radiotelegraphic traffic are in the illuminated zone. A new factor is introduced into the earlier formula, defining the intensity of the disturbance as a function of the ratio of the total atmospheric focus activity to those, of which the propagation is affected by the disturbance. Author

**N65-35996#** Technische Hochschule Munchen (West Germany). Elektrophysikalisches Institut.
**MEASURING EQUIPMENTS FOR INVESTIGATIONS OF ULF-RADIATION Technical Report No. 1**
L. Rohrer 1 Feb. 1965 32 p refs
(Contract AF 61(052)-725)
(AFCRL-65-269; AD-615491)

For investigations of naturally occurring electromagnetic radiation with a period of 10 sec to 15 sec the necessary equipment has been developed. The report describes an ULF-generator with an extremely short starting time, an amplifier with an input resistance of $70 \cdot 10^9$ ohms, and an equipment for a frequency transformation by means of a tape recorder. Author

**N65-35999#** Liege Univ. (Belgium). Dept. of Astrophysics.
**RESEARCH ON RELATIONS BETWEEN COMETARY, SOLAR AND UPPER ATMOSPHERIC PROCESSES Annual Summary Report, 1 Apr. 1964–31 Mar. 1965**
P. Swings 31 Mar. 1965 23 p
(Contract AF 61(052)-587)
(ASR-3; AFCRL-65-304; AD-615403)

Laboratory work was continued on: (1) the time resolution of spectra; (2) the spectra of several molecules of astronomical interest; (3) various instruments; and (4) the study of photomultipliers. The physical mechanisms in comets are discussed. Investigations related to space experiments are mainly concerned with the far ultraviolet spectra of stars, comets, aurorae, and artificial comets. Other programs of cometary and solar investigations were started, and preparations are being made for a search for faint comets at the 1965 airborne solar eclipse expedition. R.R.D.

**N65-36002** Harvard Coll. Observatory, Cambridge, Mass. Meteor Dept.
**UPPER ATMOSPHERIC WIND FIELDS FROM METEORIC TRAINS**
Robert F. Hughes and Allan F. Cook *In its* The Study of Meteor Phenomena, Upper Atmosphere Winds, and Turbulence and Chemiluminescence in the Upper Atmospheres 31 Dec. 1964 117 p refs (See N65-36000 24-30)

Instruments for the photography of persistent meteor trains and the methods for reduction of the photographs are described. Equations are derived for the determination of velocities in the atmosphere. If components of motion both perpendicular and parallel to the meteor trail can be measured from two stations, all three components of the velocity of the train can be measured. If only the perpendicular components can be measured from two stations the wind field may be assumed horizontal to obtain a solution. If only the perpendicular component has been determined from one station this is all that can be found. Results for five meteor trains are reported. In one case all three components were found, including a residual velocity of about 90 meters per second for the meteoric vapor-air mixture downward along some six km of the trail. Turbulent wind velocities of the order of 6 to 11 meters per second with wavelengths of the order of 4 to 10 km are indicated by three of the five trains. C.T.C.

**N65-36131#** Alaska Univ., College. Geophysical Inst.
**COLLEGE STEP SOUNDING EQUIPMENT, RECORDING SYSTEMS, AND OPERATING PARAMETERS FROM 1963 TO 1965**
Arthur E. Goddard and Howard F. Bates Jul. 1965 80 p refs
(UAG-R-166)

Several modifications and additions made to the ionospheric sounder are discussed. Expansion of the equipment and program versatility is outlined in general terms and illustrated with block diagrams which show specific points of connection to the system. Several data recording devices are described which are applicable to many types of ionospheric recording equipment. Among the devices described are a variable speed recording camera system, two types of video processors, and a high frequency transponder. All circuits are described in detail with block and schematic diagrams. A comprehensive table is included which lists the data recording system and equipment sensitivities. E.E.B.

**N65-36132#** National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
**IONOSPHERIC DATA, PART A**
30 Jul. 1965 56 p
(CRPL-F-251, Pt. A)

Tables of monthly median values of vertical-incidence ionospheric data are presented accompanied by graphs of critical frequencies and hundredths. Smoothed observed Zurich relative sunspot numbers for the period April 1954 through June 1964, are included. Also cited are world-wide sources of ionospheric data. S.C.W.

**N65-36154#** Emmanuel Coll., Boston, Mass. Oriental Science Library.
**[ABSTRACTS OF SELECTED ARTICLES IN GEOPHYSICS AND SEISMOLOGY]**
Apr. 1965 8 p Transl. into ENGLISH from Acta Geophys. Sinica (Peking), v. 13, no. 1, Mar. 1964
(Contract AF 19(628)-5073)
(E-TC-CH-65-31; AD-619261)

Brief abstracts are presented on such topics as propagation of hydromagnetic shock waves in an inhomogeneous magnetic field; geomagnetic effects of major flares in the sunspot regions of magnetic classes $\gamma$ and $\beta\gamma$; increasing the accuracy of a visual magnetometer; a study of the P and S waves at 5° to 30°, and of the structure of the earth's mantle; transmitting sources in two-dimensional seismic model experiments; microseismograph design; theory of grouping of pulsating waves; direct current method of ore prospecting; and the nonuniqueness of the Umkehr method B. M.G.J.

**N65-36177#** Ohio State Univ. Research Foundation, Columbus. Inst. of Geodesy, Photogrammetry and Cartography.
**ON GRAVITY PREDICTION USING MEAN ANOMALIES Scientific Report No. 13**

Erwin Groten Jun. 1965 19 p refs *Its* Rept. No. 47
(Contract AF 19(628)-2771)
(AFCRL-65-520; AD-620036)

The efficiency of prediction of mean gravity anomalies for areas of 1°, 2° × 2°, 5° × 5°, and 10° × 10° from known mean anomalies is studied. The least standard prediction error is found to be about 1/2 $(var)_s^{1/2}$ where $var_s$ is the variance of mean anomalies. The influence of the nearest neighbors is prevailing. The prediction from many known anomalies is about the same as from only a few known values. Author

**N65-36182#** Washington State Univ., Pullman.
**A STUDY OF FIELD ALIGNED IRREGULARITIES FROM THREE OBSERVATION POINTS**
Dale M. Ranz (M.S. Thesis) 1965 58 p refs
(Grant NSF GP-2701)
(AD-618698)

An investigation of field aligned irregularities was performed using 18 MC/S backscatter radar data from Washington State University, Stanford University, and the Plum Island Site of the Air Force Cambridge Laboratories. Differences were found in the field aligned echo (FAE) occurrence patterns at the three stations. A definite latitudinal difference of diurnal variation existed. Seasonal variation of FAE activity at WSU and AFCRL indicated peaks of activity during the summer for the quiet period of the solar cycle. Solar cycle variations at WSU included changes in the daily and seasonal times of peak occurrence of recorded FAEs. In 1958, WSU had the diurnal peak of activity at midnight and the seasonal peaks at the time of the equinoxes. Field aligned echo observations at these three stations are in general agreement with other methods of observing field aligned irregularities, particularly previous high-latitude Spread-F observations. Author

**N65-36224#** Alaska Univ., College. Geophysical Inst.
**AN INTERPRETATION OF THE AURORAL BREAKUP**
Daniel W. Swift Jul. 1965 50 p refs
(Grant NSF G-25293)
(UAGIR-165)

A dynamical model of the magnetosphere is presented to account for the main morphological features of the aurora, and the auroral breakup in particular. The aurora is the result of an internal process in the magnetosphere. It is suggested that a fluting instability on the outer boundary of the ring current belt is responsible for auroral breakup. This instability leads to a rapid flow of the ring current plasma into the tail of the magnetosphere. Particular attention is focused on the mechanisms for energizing electrons, the dynamics of the fluting instability in the magnetosphere including the dissipative effects of the ionosphere, and the structure of the ring current belt. It is stressed that the aurora gets its energy from the DR (ring current) belt. It is shown that the asymmetry of the DR belt and the observed asymmetry of the radiation belts can be accounted for by the asymmetric injection of charged particles on the day side of the geomagnetic field. Author

**N65-36283#** Joint Publications Research Service, Washington, D. C.
**DETAILED SEISMIC ZONING OF THE SELENGA RIVER DELTA AND THE ADJACENT TERRITORY**
V. S. Khromovskikh 13 Oct. 1965 27 p refs Transl. into ENGLISH from Geol. i Geofiz., Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 6, Jun. 1965 p 17-34
(JPRS-32386; TT-65-32876) CFSTI: $2.00

Using paleoseismogeologic methods, a detailed seismic zoning map of intermediate scale (1:1,000,000 and greater) was constructed for the Selenga River delta and its adjacent territory. Presented are data on the seismotectonics of the territory, techniques used to justify the boundaries of zones of different intensity in the zoned territory, factors considered in the delineation of engineering-geological regions, specific engineering-geological regions, and regions with the intensity of 10-, 9-, and 8-point earthquakes. The positioning of the boundaries of the 9-, and 10-point zones for the territory was justified on a seismotectonic basis. In the high-intensity zones, regions with small seismicity as compared to the background (rated amount) are delineated. Included are recommendations for reducing seismic danger in certain sections. S.C.W.

**N65-36300#** Sheffield Univ. (England).
**A POSSIBLE EXPLANATION OF THE APPLETON ANOMALY OF THE F2 LAYER II: A MODEL WITH UNEQUAL HORIZONTAL VELOCITIES Scientific Report No. 3**
D. W. Windle and P. C. Kendall [1965] 14 p refs Submitted for Publication Prepared in Cooperation with Alaska Univ.
(Contract AF-EOAR-64-74)
(AFCRL-65-621; AD-620243)

The effects of an assumption that the neutral air in the F2 layer is set in horizontal motion by the ionization are examined further. Here, it is assumed that the horizontal velocity of the neutral air is a fixed proportion of the horizontal velocity of the ionization. The model F2 layer discussed is in equilibrium at noon and there is no electrodynamic drift. The earth's magnetic field is assumed to be that of a geocentric dipole whose axis coincides with the earth's axis of rotation. The sun's radiation is assumed to be symmetrically incident on the earth. It is found that the theoretical enhancement of the equatorial trough in $N_m$, discovered when the horizontal velocities are the same (Kendall and Windle, 1965), is only present to a marked degree when the horizontal velocities differ by 2.5% or less. However, although moderate induced horizontal winds may have little effect on the shape of the equatorial trough, they do affect the overall magnitude of N and $N_m$ by a factor which may be as large as three. Author

**N65-36331#** International Business Machines Corp., Cambridge, Mass. Cambridge Space Systems Dept.
**ATMOSPHERIC DENSITY DETERMINATION BY A NUMERICAL INTEGRATION PROCEDURE Scientific Report No. 1, Jul. 1964–Mar. 1965**
Arnold S. Bramson and Jack W. Slowey May 1965 25 p refs
(Contract AF 19(628)-4192)
(AFCRL-65-416; AD-620678)

Atmospheric density determination may be carried out by a careful reduction of satellite observations over long periods of time. The particular approach currently being investigated consists of a numerical integration procedure combined with a differential correction scheme where discrepancies between computed and observed satellite position and velocity are reconciled by adjusting the assumed atmospheric model, thereby yielding corrected or refined density data. An important advantage of this technique is its applicability to satellites entering the decay stage where the effects of atmospheric drag are considerable and relatively few observations are available. This report describes a numerical integration computer program which has been written and which is capable of simulating the motion of a satellite disturbed by various perturbative forces. Author

**N65-36332#** Air Force Cambridge Research Labs., Bedford, Mass.
**GIANT DESICCATION POLYGONS OF GREAT BASIN PLAYAS**

James T. Neal Aug. 1965 40 p refs *Its* Environ. Res. Papers No. 123
(AFCRL-65-575; AD-620571)

Giant desiccation fissures observed on 39 playas (dry lakes) in the Great Basin are greater in size and causative rupture stress than are the typical, small, surface mud cracks. Giant open fissures may be a meter wide and more than 5 m deep, whereas the typical shallow mud cracks are a few centimeters wide and about 25 cm and more deep. The fissures form polygonal patterns that range from 15 to 100 m and more across, with intersections predominantly at approximately right angles. The fissures themselves follow sinuous, irregular lines. Thus, the patterns are for the most part "irregular random orthogonal polygons". Fissures follow a cycle of growth and destruction: fresh, sediment filled, vegetated, and relict fissures comprise the major geomorphic forms. The patterns can be easily identified on airphotos, and can thus, through inference, offer reconnaissance information on the playa environment. Author

**N65-36374#** National Physical Lab., New Delhi (India). Radio Propagation Unit.
**IONOSPHERIC DATA, JANUARY 1964**
Jan. 1964 66 p
(RRC-A104) CFSTI: HC $3.00/MF $0.75

Ionospheric observations taken from stations in Delhi, Bombay, Madras, Tiruchirapalli and Trivandrum, Haringhata, Ahmedabad, Hyderabad, and Kodaikanal, India are presented. Details about the ionospheric equipments used at these stations are included. E.E.B.

**N65-36380#** National Physical Lab., New Delhi (India). Radio Propagation Unit.
**IONOSPHERIC DATA, FEBRUARY 1964**
[1964] 66 p
(RRC-A105) CFSTI: HC $3.00/MF $0.75

Ionospheric and radio propagation data are presented from Delhi, Bombay, Madras, Tiruchirapalli and Trivandrum, Haringhata, Ahmedabad, Hyderabad, and Kodaikanal, India. Some relevant information about the stations and the equipments used at these stations are included. E.E.B.

**N65-36388#** Weapons Research Establishment (Australia).
**PRESSURE DISTRIBUTIONS ON PLANAR AND CRUCIFORM DELTA WINGS ATTACHED TO CYLINDRICAL BODIES IN SUPERSONIC FLOW. PART II: EXPERIMENTAL RESULTS FOR MACH NUMBERS 2.00 AND 2.58**
E. R. A. Landers May 1965 45 p refs
(WRE-TN-HSA-107) CFSTI: HC $2.00/MF $0.50

Pressure distributions have been measured on planar and cruciform delta wings with 50° leading edge sweepback attached to cylindrical bodies, at Mach numbers of 2.00 and 2.58. Results have been obtained over an incidence and sideslip range of ±5°. The results for zero incidence and sideslip have been compared with theoretical estimates of the pressure distribution due to wing thickness. Within the experimental accuracy good agreement is obtained between theory and experiment. Author

**N65-36398*#** Maryland Univ., College Park. Computer Science Center.
**PATTERN RECOGNITION. V: SAMP—A COMPUTER PROGRAM FOR ESTIMATING SURFACE AREA FROM CONTOUR MAPS**
Mark S. Mononier, John L. Pfaltz, and Azriel Rosenfeld Aug. 1965 50 p refs
(Grant NsG-398)
(NASA-CR-67496; TR-65-21) CFSTI: HC $2.00/MF $0.50 CSCL 08B

A FORTRAN program has been written which computes a linear approximation to the surface area of any given portion of a digitized contour map. The program also estimates the slop gradient at each point. It is slower, but appears to be somewhat more accurate, than other proposed methods of estimating average slope from contour maps. Author

**N65-36434*#** Pennsylvania State Univ., University Park. Ionosphere Research Lab.
**A SUBSONIC PROBE FOR THE MEASUREMENT OF D-REGION CHARGED PARTICLE DENSITIES**
R. G. Willis 1 Sep. 1965 49 p refs *Its* Sci. Rept. No. 245
(Grants NsG-134-61; DA-ARO(D)-31-124-G659)
(NASA-CR-67487) CFSTI: HC $2.00/MF $0.50 CSCL 04A

The philosophy, theory, and preliminary results of a program to measure charged particle number densities in the D-region of the ionosphere are presented. The instrument used is a subsonic, parachute-borne, bipolar probe with a planar collector. The probe geometry and electronics, the relevant theory, and the experimental results from recent Arcas rocket shots are reported. Results indicate positive ion densities of the order of $10^3$ $cm^{-3}$ from 60 to 70 kilometers. An error analysis of these results shows that the principal error results from an uncertainty in probe potential stemming from solar ultraviolet irradiation of the sides of the probe during daytime shots. This probe system is significant in that the results are independent of angle of attack, and in that the commonly used free-molecular ram theory is replaced by a continuum theory more appropriate to the region 40 to 80 kilometers. Author

**N65-36436*#** California Univ., Los Angeles. Inst. of Geophysics and Planetary Physics.
**THE USE OF ARTIFICIAL SATELLITES FOR GEODESY**
William M. Kaula [1965] 35 p refs Presented at Am. Astronautical Soc. Ann. Meeting, San Francisco, 1965 *Its* Publ. No. 452
(Contract NSR-05-007-060; Grant NsG-216)
(NASA-CR-67491) CFSTI: HC $2.00/MF $0.50 CSCL 08E

Discussions are presented on the purposes and principles of artificial geodetic satellites, the results which they have obtained, and their currently planned projects and future prospects. R.N.A.

**N65-36444*#** RAND Corp., Santa Monica, Calif.
**SPHERICAL HARMONIC ANALYSES FOR THE SPHEROIDAL EARTH, II**
A. B. Kahle, J. W. Kern, and E. H. Vestine Sep. 1965 16 p refs
(Contract NASr-21(05))
(NASA-CR-67399; RM-4750-NASA) CFSTI: HC $1.00/MF $0.50 CSCL 08F

A spheroid approximates the earth more accurately than does a sphere. Before analyzing the data over the surface of the earth by spherical harmonic series, we must correct them to the appropriate values on a true sphere. The change in the earth's radius and latitude, and in the direction of the vector components must be considered. The corrections have been applied here to values derived from existing analyses of the earth's magnetic field. The changes are significant, the largest being about 120γ in the $g_3^3$ term. Author

**N65-36474#** Joint Publications Research Service, Washington, D. C.
**SYSTEM FOR CONTINUOUS MEASUREMENT OF PHYSICAL PARAMETERS IN THE SEA**
P. A. Borovikov 15 Oct. 1965 6 p Transl. into ENGLISH from Okeanologiya (Moscow), v. 5, no. 3, 1965 p 566–568 (JPRS-32429; TT-65-32918) CFSTI: $1.00

A special electric winch placed at the bottom of the sea is the basis for two continuous measurement devices for determining physical parameters in the sea. A measurement probe with a bank of transducers is riveted to the end of the rope cable wound onto the drum of the winch. Rotating the winch, the measurement probe is lowered and performs continuous measurements. The speed of the device for vertical probing is 18 meters per minute. A similar device for tracking was designed along similar lines with a speed of 2 meters per minute. During operation, a definite frequency band is shunted to each measurement parameter over the entire range of variation. A base frequency of 18 kc is obtained from a quartz crystal oscillator. The devices have a broad region of application and can be used for specific quantities such as temperature, illumination, and temperature gradients. The probes can be used to depths of 300 meters. E.E.B.

**N65-36493#** Sandia Corp., Albuquerque, N. Mex.
**FALLOUT REPORT: BETA-GAMMA RADIOACTIVITY IN AIR AT SANDIA LABORATORY, JANUARY THRU JUNE 1965**
R. E. Womelsduff Oct. 1965 12 p refs
(SC-RR-65-464) CFSTI: $1.00

A report of the gross beta-gamma radioactivity (expressed as micromicrocuries per cubic meter) of air samples collected during the first half of 1965. Author

**N65-36494#** Holman (John F.) and Co., Inc., Washington, D. C.
**CONTRIBUTION TO BAROMETRIC MEASUREMENT OF ALTITUDE IN CARTOGRAPHY**
Dietrich Moeller (Ph.D. Thesis) Ft. Belvoir, Va., Army Engr. Res. and Develop. Labs., Aug. 1965 105 p refs Transl. into ENGLISH of "Beiträge zur Barometrischen Höhenmessung" Bayerische Akad. der Wiss., Deutsche Geodatische Komm., 1962 89 p
(Contract DA-44-009-AMC-930(T))
(ERDL-T-1790-65-R; AD-467393)

Starting with the relations of the standard atmosphere, an altitude formula is derived which confirms the validity of the Jordan formula. Further development produced a new altitude formula, more suitable for the use of altimeters provided with linear metric altitude graduations, which no longer contains a logarithmic member and indicates the further advantage of the altimeter graduated in accordance with the standard atmosphere, that is, appreciably smaller corrections of temperature in general. To facilitate calculation, the altitude formula is simplified so that the measured difference of standard altitude can be converted to the most probable difference of altitude in general by 2 and, under extreme conditions, by at most 4 additive additions, tabulated in nomograms.
R.N.A.

**N65-36554*#** Cornell Univ., Ithaca, N. Y. Center for Radiophysics and Space Research.
**EFFECTS OF SEVERAL PARAMETERS ON THE OPTICAL PROPERTIES OF SOME ROCK POWDERS, WITH APPLICATIONS TO THE MOON**
Hsiu Yung Chen Chow Jun. 1965 49 p refs
(Grant NsG-382)
(NASA-CR-67554; CRSR-200) CFSTI: HC $2.00/MF $0.50 CSCL 08G

The effect of several parameters on the optical properties of some rock powders were investigated to reduce the range of materials suspected of composing the moon's surface. Experiments showed that photometric and polarometric properties of rock powders are critically dependent on particle size and hydrogen ion irradiation dose; surface compaction and chemical composition have less effect. A moderately compacted powdered surface with a particle size distribution which peaks between 1 and 10 microns and irradiated by hydrogen ions for a dose about 90 coul/$cm^2$, possesses optical properties similar to those of the moon. Varying the chemical composition changes the optical curves slightly; however, by minor adjustments of size distribution and dose, the lunar type curves can be obtained from many different types of rock powders. It is not possible to decide whether the different photometric characteristics of the mares, highlands, and craters are due to differences in chemical composition or to different times of exposure to the solar wind. R.N.A.

**N65-36609#** Agentina. Comision Nacional de Energia Atomica, Buenos Aires.
**CONTRIBUTION OF THE STUDY OF THE ALLUVION OF THE RIO TERCERO (CORDOBA) TO THE INVESTIGATION OF MONAZITE AND OTHER DENSE MINERALS [CONTRIBUCION AL CONOCIMIENTO DEL ALUVION DE RIO TERCERO (CORDOBA) SU INVESTIGACION POR MONACITA Y OTROS MINERALES DENSOS]**
Victorio Angelelli and Edmundo Chaar 1965 40 p In SPANISH *Its* Informe No. 139 CFSTI: HC $2.00/MF $0.50

Alluvial material from the Rio Tercero in Argentina was analyzed for its content of monazite and other dense minerals including magnetic and opaque nonmagnetic minerals, granite, and zircon. Approximately 31,687,000 tons of alluvial material were processed and separated magnetically and by weight. The material contained 19% magnetic minerals, 11% opaque nonmagnetic minerals, 4% granite, and 173 grams per ton of monazite. The zircon content was very low. The monazite, which came to 5482 tons, contained 210 tons of $ThO_2$ and 3350 tons of rare earth oxides. The monazite and other dense mineral content was lower than expected. R.N.A.

**N65-36783#** RAND Corp., Santa Monica, Calif.
**A STOCHASTIC MODEL OF THE FORMATION AND SURVIVAL OF LUNAR CRATERS, III: FILLING AND DISAPPEARANCE OF CRATERS**
A. H. Marcus Aug. 1965 37 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4682-PR; AD-620228)

A previous model is extended to include the effects of the disappearance of craters due to filling by dust or lava. Both the age distribution and expected number density of lunar craters are obtained as functions of crater diameter and of time. These results are applied to the meteoroidal impact hypothesis of the origin of lunar craters. Good agreement is obtained with observed number densities on the lunar continents and maria. It is assumed that the rate of filling of craters on the continents corresponds to the rate of meteoritic accretion, and the rate of filling on the maria is 50 to 100 times larger than on the continents, corresponding to filling of mare craters by lava. Author (TAB)

**N65-36828#** Naval Oceanographic Office, Washington, D. C.
**REPORT OF THE ARCTIC ICE OBSERVING AND FORECASTING PROGRAM—1963 Special Publication**
May 1965 193 p *Its* Ann. Rept. No. 12
(SP-70(63); AD-620875) Available from Naval Oceanog. Office, Washington, D. C.: $2.10

A summary of Navoceano and Danish ice operations during 1963 is presented. Operational aspects of obtaining and disseminating ice information and the ice forecasting and observing program are discussed. Ice charts depict observed synoptic ice conditions throughout the year. Locations of oceanographic stations occupied in the polar and subpolar regions are included. Author (TAB)

**N65-36847#** Air Force Cambridge Research Labs., Bedford, Mass. Upper Atmosphere Physics Lab.
**MEAN ATMOSPHERIC PROPERTIES IN THE RANGE 30 TO 300 KM Air Force Surveys in Geophysics No. 164**
K. S. W. Champion Jun. 1965 49 p refs
(AFCRL-65-443; AD-619170)

A planned COSPAR Publication contains a set of atmospheres for several latitudes and times of year for the altitude region 30 to 80 KM developed by G. V. Groves. A second set of atmospheres was developed by W. Priester and I. Harris (The Upper atmosphere is the range from 120 to 800 KM' proposed CIRA, 1964) for the region between 120 and 800 KM for various solar fluxes and times of day. For the purpose of connecting these two sets of atmospheres and also to provide average values of the physical properties, a mean reference atmosphere was prepared as described in this report. The mean 30 and 80 KM the model represents mean conditions throughout the year for latitudes near 30 degrees. Between 120 and 300 KM the model represents mean conditions over a 24-hour period for a 10.7-CM wavelength solar flux Fof 150 × 10 to the minus 22D power W/SQ M/C/.S. Between 80 and 120 KM a model was developed which provides a smooth connection between the above two parts of the mean atmosphere. Author (TAB)

**N65-36848#** Uppsala (Sweden). Seismological Inst.
**RHEOLOGIC PROPERTIES OF THE SOLID EARTH Final Report, May 1, 1962–May 31, 1965**
Markus Bath and Seweryn J. Duda 24 Jun. 1965 85 p refs Prepared in part by Calif. Inst. of Tech.
(Contract AF 61(052)-588; ARPA Order 180-62; Proj. Vela-Uniform)
(AFCRL-65-565; AD-619388)

The paper is based on data for the largest earthquakes (magnitude 7 or above) in the interval 1897–1964. Strain energy release and numbers of earthquakes are studied both in relation to their time and space distribution. The circum-Pacific belt exhibits two pronounced concentractions of strain energy release, in its NW and SE part. There is a general decrease of seismic activity over the period investigated. The whole material used is presented in a table, probably the most complete list of large earthquakes so far published. Author

# 14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

**N65-35814#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**DEVICE FOR AUTOMATIC CHANGING OF THE MAGNETIC FIELD OF A MASS SPECTROMETER**
V. I. Zubkov and A. M. Ivanov 9 Jul. 1965 6 p Transl. into ENGLISH from Soviet Patent No. 156713 (Appl. No. 783488/26-10, 20 Jun. 1962) 3 p
(FTD-TT-65-491/1+2+4; AD-614019)

A device is described for automatically changing the magnetic field of a mass spectrometer. It consists of a reversible electric motor, a reducer, regulating disks, and a relay throw-over switch which changes the direction of the motor's turning and the potentiometer contacts to eliminate idle running of the scanning and to assure a continuous recording of the spectrum. R.N.A.

**N65-35822#** Itek Corp., Palo Alto, Calif. Vidya Div.
**AIRBORNE SPECTRAL-RECONNAISSANCE SYSTEM VELA CLOUD GAP PROGRAM Final Report**
John E. Wilson, Callie Lukermann Craig, Charles W. Hanson, Donald H. Kelly, Thomas W. Mark et al 20 Mar. 1965 45 p
(Contract AF 33(657)-7381; ARPA Order 500)
(AFCRL-65-197; VIDYA-179; AD-615434)

The nine lens camera built as a prototype for project Vela was redesigned and rebuilt, and now includes a stainless steel shutter curtain, lenses individually focused for best resolution in each band, adjustable fiducial markers allowing optical registration in composite printing, new optical projection counters, and a new electrical remote control box and system console. Other improvements were made to increase reliability and reduce maintenance. The Maurer P-220 cameras of the prototype multiband system were replaced with the more reliable Mitchell-Vinten F-95 70-mm reconnaissance cameras. The 14L spectrometer was tested and previous difficulties isolated. Its unsuitability is due to the nonlinear response of the light biased cadmium selenide detector. Nonlinearities cannot be corrected with the present data reduction system and therefore the spectrometer is not recommended for further use. Spectrometers with silicon solar detectors were satisfactory. A system of analyzing spectrograms by visual inspection was replaced by a series of two computer programs. R.N.A.

**N65-35985#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CALIBRATION OF SURVEY CAMERAS ON THE BASIS OF MODEL DEFORMATIONS**
H. Schoeler 20 Apr. 1965 13 p Transl. into ENGLISH from a publ. of VEB Carl Zeiss Jena (E. Germany), p 1–7
(FTD-TT-65-246/1+2; AD-614399)

Distortion curves for an optical system, which can become effective by changing camera constants, are derived and depicted. The derivation of the camera constants from the requirement of making the model formation in conjunction with a minimum is presented. Equations are obtained showing the modal warping due to distortion by well-known elements of the reciprocal orientation. In addition to determining the camera constants, the residual dis-deformations of a level model was calculated according to a derived image equation. The depicted curves show these evaluations in the elevation-linear representation of the horizontal parallaxes, reduced to the image surface. L.S.

**N65-36022** Marine Engineering Lab., Annapolis, Md.
**A SENSING DEVICE FOR THE MEASUREMENT OF STEAM QUALITY**
M. Greenberg *In* ONR Automation and the Navy [1964] p 127-147 refs (See N65-36014 24-08) CFSTI: $3.00

A special-purpose, nondispersive, near-infrared steam quality analyzer is described. The instrument measures the attenuation of infrared radiation by steam, which consists of water vapor and may contain liquid water droplets. The analyzer incorporates the following characteristics: continuous and automatic measurement, measurement without side steam sampling and without obstructing the steam flow, operation over a steam quality range of 75% to 100%, accuracy of ±1%, and instantaneous readout when necessary. The major components are described in detail. Evaluations were carried out for such parameters as drift characteristics, response time, effects of variations in mass steam flow, response to changes in steam quality, effects of variations in steam pressure, and reproducibility. C.T.C.

**N65-36111*** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**EXPERIMENT MSC-2, PROTON-ELECTRON SPECTROMETER ON GEMINI IV**
James Marbach *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 149–159 ref (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

Data on the Gemini-4 proton-electron spectrometer, which was used to measure the radiation environment in an anomaly in the geomagnetic field that was intersected by the Gemini-4 orbits, are reported. Preliminary count-rate data of protons and electrons from a typical pass through the anomaly are presented which show a smooth rise to peaks of approximately $6 \times 10^4$ electrons/cm$^2$-sec and $10^2$ protons/cm$^2$-sec. The magnetometer data show that the spacecraft was tumbling during this pass, which produced the apparent dip in the data. Data from revolution 52 were similar to those from revolution 7, reaching peaks of $3 \times 10^4$ electrons/cm$^2$-sec, and $10^2$ protons/cm$^2$-sec. The dip in the proton data is unexplained. Typical electron and proton spectra taken at different times through the anomaly on revolution 7 are included. Speculation is made concerning the usefulness of these and related experiments in providing source terms for the calculation of radiation doses received by the crew members. S.C.W.

**N65-36112*** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**EXPERIMENT MSC-3, TRI-AXIS MAGNETOMETER ON GEMINI IV**
William D. Womack *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 161–170 (See N56-36100 24-30) CFSTI: HC $5.00/MF $1.25

Data from a tri-axis magnetometer which was used on the Gemini-4 for determining the magnitude and direction of the local geomagnetic field with respect to the spacecraft, are analyzed. Summarized are data from three revolutions (7, 22, and 51) which were recorded while operating through the area known as the South Atlantic anomaly region. Results indicated that the data on the magnetometer experiment are not only important to the proton-electron spectrometer experiment, but also to any directional charged-particle experiments that may be conducted. It was further concluded that the observed stray magnetic fields were results of spacecraft structure rather than current flows produced within the spacecraft electrical systems. Although the experiment, as posed, was successful, efforts are being made on future missions to reduce spacecraft stray fields, thus enabling more accurate data to be obtained. S.C.W.

**N65-36122#** Battelle-Northwest, Richland, Wash.
**DETECTION OF RADIONUCLIDE CONTAMINATION ON FACE MASKS**
E. M. Sheen and G. D. Crouch Sep. 1965 12 p refs
(Contract AT(45-1)-1830)
(BNWL-144) CFSTI: $1.00

Described is an experimental monitoring instrument which was developed to detect and measure fission product contamination on the inner and outer surfaces of protective face masks. The instrument includes two large scintillation detector assemblies employing light pipes to conform to mask surfaces, and one smaller scintillation detector to monitor the nose piece of the mask. All circuitry employed is solid state, and a schematic of this circuitry is included. The instrument can detect 10 nanocuries of $Pm^{147}$, a low energy beta emitter. C.T.C.

**N65-36128#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.
**DRUM DISPERSION EQUATION FOR LITTROW TYPE PRISM SPECTROMETERS**
M. Sidran, H. Stalzer, and M. Hauptman (Astrosystems Intern., Inc., Fairfield, N. J.) Jun. 1965 46 p refs
(RM-283)

A simple and accurate method of calibrating Littrow-type prism spectrometers was developed, in which an approximate equation was used to relate wavedrum reading to refractive index. An exact equation was first derived by means of geometric optics, assuming focusing and collimation. An approximate equation was then derived from the exact expression by using several small angle approximations. This equation was used to calculate drum positions for 40 spectral lines in the 3000 Å to 23000 Å range, employing several sets of constants based on different measured points. The difference between calculated and measured drum positions was usually of the same order as the instrumental error observed for a two degree temperature variation at the prism. The wavelengths of nine emission lines were calculated from their measured drum positions, using tabulated data for neighboring wavelengths. The errors in calculated wavelengths were comparable to the errors in calculated drum positions. Recommendations are also included for improving the limiting accuracy of the method. Author

**N65-36156#** Michigan Univ., Ann Arbor. Infrared Lab.
**SPECTRAL REFLECTANCE MEASUREMENTS COMPARED WITH PANCHROMATIC AND INFRARED AERIAL PHOTOGRAPHS**
Charles E. Olson, Jr. Sep. 1964 24 p
(Contract Nonr-1224(44))
(Rept.-4864-8-T; AD-603499)

Spectral reflectance measurements made with a trailer-mounted spectroreflectometer near Dexter, Michigan, in August 1963, are presented. Curves of foliage reflectance in the 350- to 2,750-millimicrons wavelength range are included. Predicted tonal contrasts based on the reflectance data are compared with panchromatic and infrared aerial photographs of the study area. Actual results agreed with predicted tonal contrasts except for needled trees which appeared darker-toned on the infrared photography than had been predicted. Author

**N65-36336#** Royal Aircraft Establishment, Farnborough (England).
**SHORT DESCRIPTION OF THE HIT-INDICATOR-INSTRUMENT (DS.TAG.2a) AND ACCOUNT OF RESULTS OF THE GROUND-GROUND FIRING TRIAL FROM 20th TO 27th MAY, 1964, IN MEPPEN [KURZBESCHREIBUNG DES TREFFERANZEIGEGERATES (DS.TAG.2a) UND ERGEBNISBERICHT VON DEN BODEN-BODEN SCHIESSVERSUCHEN VOM 20–27.5.1964, IN MEPPEN]**

H. Friedel Jul. 1965 11 p Transl. into ENGLISH of Dornier System G.M.B. (West Germany) Rept. No. 170/64
(RAE-LIB-TRANS-1116) CFSTI: HC $1.00/MF $0.50

An experimental model of a scorer system, developed by Dornier Systems Ltd., for the West German Defence Ministry, was tested in ground to ground firings at the Meppen Ranges during 20th to 27th May 1964. This equipment was a passive dual Doppler radio system—designed to be incorporated in a towed target to be used for practice by anti aircraft gun batteries. Results of these tests demonstrated that the scoring accuracy was acceptable, but defects in equipment and test methods introduced some deviation from theoretical expectations. Author

**N65-36359#** Kernforschungsanlage, Juelich (West Germany). Institut für Reaktorexperimente.
**ARRANGEMENT OF A $\beta$–$\gamma$ COINCIDENCE APPARATUS FOR ABSOLUTE DETERMINATION OF RADIOACTIVE SOURCE STRENGTH (SPECIAL APPLICATION TO ACTIVATED GOLD FOILS) [EINRICHTUNG EINER $\beta$–$\gamma$ KOINZIDENZ-APPARATUR ZUR ABSOLUTBESTIMMUNG RADIOAKTIVER QUELLSTARKEN (SPEZIELL ANGEWANDT AUF AKTIVIERTE GOLDFOLIEN)]**
W. Schneider 20 Mar. 1964 24 p refs In GERMAN
(JUL-187-RX) CFSTI: HC $1.00/MF $0.50

The arrangement, suitability, and control measurements with a $\beta$–$\gamma$ coincidence apparatus, which will serve for absolute determination of $^{198}Au$ radioactivity in gold foils (20$\mu$ thick, $\leq$ 1cm$^2$ circular surface), are described. On the basis of the measurements obtained, the absolute determination of neutron flux, as well as the power calibration in the startup program of the FRJ-2, were carried out. The activity measurement region for the target samples ranged from 0.002 to 1 $\mu$C; the error in measurement amounted to approximately $\pm$2% under good conditions. Author (NSA)

**N65-36360#** Kernforschungsanlage, Juelich (West Germany). Institut für Plasmaphysik.
**A TROCHOID SPECTROMETER FOR MEASUREMENT OF ENERGY DISTRIBUTION OF IONS IN PLASMA [EIN TROCHOIDSPEKTROMETER ZUR MESSUNG DER ENERGIEVERTEILUNG VON IONEN IN PLASMEN]**
C. Bastian Oct. 1964 14 p refs In GERMAN; ENGLISH summary
(JUL-200-PP) CFSTI: HC $1.00/MF $0.50

An ion spectrometer for plasma physics is described. The analysing structure combines crossed uniform electric and magnetic fields which provide a mass focusing and an energy selection. For a given mass of the ions, four stigmatic images of the inlet diaphragm appear on the spectrogram. They correspond to ions of four definite energies which are simultaneously recorded. A spectrometer of this type is designed for protons ranging from 500 eV up to 25.000 eV. The protons can be recorded either on a photographic plate, by four Faraday cups, or by four scintillations counters. Author

**N65-36363#** Atomic Energy of Canada, Ltd., Chalk River (Ontario).
**PROBLEMS IN BETA DOSE MEASUREMENT AT CRNL**
W. G. Cross Jul. 1965 11 p Presented at the Health Phys. Soc., Los Angeles, 17 Jun. 1965
(AECL-2281) CFSTI: HC $1.00/MF $0.50

Energy and angular responses of film dosimeters and survey meters to beta radiation are studied. Data are presented on badge and meter ability to detect true dosage, to distinguish between beta and gamma radiation, and angular sensitivity was also investigated experimentally. Both skin and whole body radiation due mainly to exposure to laboratory equipment contaminated with fission products are considered. J.M.D.

**N65-36364#** Atomic Energy of Canada, Ltd., Chalk River (Ontario).
**A PORTABLE TRITIUM-IN-AIR MONITOR**
F. Sannes and B. Banville Jul. 1965 20 p
(AECL-2283) CFSTI: HC $1.00/MF $0.50

A plastic scintillator detector has been developed for the measurement of tritiated water vapour in air. The scintillations produced by the beta rays from tritium are detected by two photomultiplier tubes mounted on each end of the scintillator detector. A tunnel diode coincidence circuit and a three channel pulse height selector are employed to analyze the photomultiplier pulses. With this system, detection efficiencies of 20% have been observed. Concentrations as low as 1 $\mu\mu$Ci/ml or 0.2 MPC can be measured. An electronic circuit has been incorporated into the instrument to make it less sensitive to external gamma radiation. The response time of the system to a sudden increase in tritium concentration in the sampled air is one minute, and approximately five minutes for a corresponding sudden decrease. Author

**N65-36366#** United Kingdom Atomic Energy Authority, Harwell (England). Nuclear Physics Div.
**THE PREPARATION OF LITHIUM-DRIFTED GERMANIUM DIODES AND THEIR USE AS GAMMA RAY DETECTORS**
B. W. Hooton Jul. 1965 15 p refs
(AERE-R-4921) HMSO: 2s 6d

Techniques used in the preparation of lithium-drifted germanium diodes are discussed, and parameters used in determining their usefulness for $\gamma$-ray spectroscopy are evaluated. The detectors were prepared from P-type, gallium doped, Czochralski (pulled) crystals in the 100-orientation, of resistivity 40-ohm-cm with a dislocation density of 500/cm$^2$. Evaluated were the detector's effective volume and its resolution. Data on the characteristics of $\gamma$-ray spectra are included. S.C.W.

**N65-36386#** Royal Aircraft Establishment, Farnborough (England).
**SOURCES OF ERROR IN PRECISION FORCE FEEDBACK ACCELEROMETER, AND METHODS OF TESTING**
I. L. Thomas, R. W. Plumbly, and R. J. Pitt London, Min. of Aviation, Jan. 1960 52 p
(RAE-TN-IAP-1076) CFSTI: HC $3.00/MF $0.50 (Declassified)

An attempt is made to define the terms commonly used in connection with force feedback accelerometers. The various sources of error are discussed and some information is given concerning present day methods of testing. The difficulties of obtaining accurate calibration figures for accelerations greater than 1g are stressed. This information may be of interest to systems engineers and instrument manufacturers who are not yet fully conversant with the characteristics of precision accelerometers, but it is written primarily around the accelerometer as a self contained component, rather than as a part of a navigation system. Author

**N65-36411#** Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.
**AN AUTOMATIC POTENTIOMETRIC TITRATOR**
E. E. Wuschke and R. B. Stewart Apr. 1965 11 p refs
(AECL-2262) CFSTI: HC $1.00/MF $0.50

An automatic potentiometric titrator with a sensitivity of 10 microvolts is described. It provides automatic selection of fore or back titration and variable flow-rate to ensure rapid titration without overshoot. A timer is included to avoid transient end-points. Author

**N65-36412#** Atomic Energy of Canada, Ltd., Chalk River (Ontario).
**CALIBRATION OF TRITIUM-IN-AIR MONITORS**
B. Banville May 1965 22 p
(AECL-2265) CFSTI: HC $1.00/MF $0.50

A method primarily intended for the calibration of continuous tritium-in-air detectors for tritium in the form of water vapour is presented. It can also be used to study the effects of a change in the environmental conditions on the performances of a detector. The parameters that can be controlled are the tritium concentration, the absolute water content of the air, the flow rate of the sampled air and to a limited extent the atmospheric pressure. The system used consists essentially of a source of dry air which is bubbled into tritiated water under controlled conditions before being passed through the detector under test. The air is then flowed through a high efficiency tritium water vapour collector. The volume of air sampled and the concentration of the tritium in the tritium collector give the actual activity of the air sampled in the detector under test. This method is capable of yielding a maximum precision of 3 to 4% in the measurement of tritium concentrations in the air produced. Author

**N65-36413#** Atomic Energy of Canada, Ltd., Chalk River (Ontario).
**A GAMMA RAY SCANNER FOR DIAGNOSTIC RADIOGRAPHY**
R. L. Clarke Jun. 1965 38 p refs
(AECL-2270) CFSTI: HC $2.00/MF $0.50

The application of gamma emitting isotopes such as $Co^{60}$ to diagnostic radiography is considered. It is shown that with high efficiency detectors, such as NaI scintillation counters, it is possible in principle to get equal density resolution over a given volume in the interior of a subject by observation of either the transmitted gamma rays or Compton scattered gammas. The latter system is shown to be less sensitive to interference by objects lying in the path of the incident or emerging beams. Experiments are described which show the resolution of small inclusions whose density differs from the surrounding volume by less than 5%. It is shown that the experimental equipment could be scaled up to give a device which would be practical for medical work. It appears that the major application of the system may be in the resolution of soft tissues. Author

**N65-36463#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**DESIGN OF MAGNETIC PICKUP PROBES FOR WIDE BAND AND HIGH FREQUENCY RESPONSE**
E. A. Valsamakis Jun. 1965 29 p refs
(RM-285)

The magnetic pickup probes, or coils, considered are used to monitor time varying magnetic fields. Plots relating the coil circuit parameters and the system bandwidth are given to facilitate the design of such probes. The coils are examined in terms of an arbitrary coil resistance and characteristic impedance. Author

**N65-36510#** General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.
**TWO-PHASE FLOW AND HEAT TRANSFER IN MULTIROD GEOMETRIES Second Quarterly Progress Report, Jan. 26–Apr. 25, 1965**
May 1965 10 p ref
(Contract AT(04-3)-189)
(GEAP-4863) CFSTI: $2.00

An annular test section apparatus for air-water flow structure measurements is in operation. Single-phase and two-phase pressure drop data, operating both as a simple round tube and as a concentric annulus, agree with well-known correlations. The inlet mixing device appears to provide fully developed two-phase flow in the test section. Thus, this apparatus is suitable for meaningful detailed flow structure measurements. Instrumentation development continues. Difficulty in obtaining true isokinetic flow sampling has been encountered. Five probe designs have been tested. A direct wall shear measurement instrument model has been designed and tested. Author

**N65-36532#** Stanford Research Inst., Menlo Park, Calif.
**DEVELOPMENT OF A PHOTOGRAPHIC IDENTIFICATION SYSTEM FOR REACTOR FUEL ELEMENTS Progress Report No. 1, 1 Dec. 1963–1 Jun. 1964**
James S. Mills [1964] 7 p
(Contract IAEA/244-RB)
(NP-14974)

A photographic identification system for reactor fuel elements has been designed and its components have been selected. The design is basically a photographic telemicroscope with an optical pipe for viewing below water surfaces. The measured resolution of the air path system has been found to be about 0.8 sec of arc on photographic film. The resolution of the entire system will be reported later. Identification techniques will be studied in great detail using both the telemicroscope and laboratory devices. For the purpose of establishing a fool-proof mark, corrosion studies must be made of the mark on fuel cladding metal surfaces. A corrosion loop has been designed and constructed for this purpose. Tests made to date are described and future work is outlined. Author

**N65-36542#** California Univ., Livermore. Lawrence Radiation Lab.
**DEMONSTRATION MODEL OF THE CAUCHOIS SPECTROMETER**
B. G. Saunders 31 Mar. 1964 7 p
(Contract W-7405-ENG-48)
(UCRL-7799)

The Cauchois spectrometer for the measurement of gamma ray photon energies is described. The spectrometer was designed for the investigation of gamma rays arising from the capture of thermal neutrons in various materials. The instrument is small enough to be placed on a bench or table for operation by students. A model of the spectrometer can be easily built using light rays instead of X-rays or gamma rays since the focusing property depends on the law of reflection which is identical for glass surfaces and atomic planes. E.E.B.

**N65-36563*#** TRW Systems, Redondo Beach, Calif.
**STUDY OF LUNAR LANDING SENSOR PERFORMANCE Final Report**
C. B. Coulbourn, Jr. 22 Sep. 1965 183 p refs *Its* Rept.-8411-6004-RU000
(Contract NAS8-5205)
(NASA-CR-67566) CFSTI: HC $5.00/MF $1.25 CSCL 14B

Lunar landing sensors were studied for three types of sensors: (1) an extended range altimeter; (2) a short range altimeter–velocity sensor; and (3) a beacon tracking radar. The characteristics of each are tabulated. A transmitting frequency of about 10 gc appears to be optimum for each of the systems except the beacon tracker. A much lower transmitting frequency of about 300 to 600 Mc appears best for the beacon tracker. An evaluation summary of antennas of the types most suitable for use with the various lunar landing sensors is given. Also, modulated varactor power sources were evaluated. Unified transmitter–receiver systems comprising an extended range altimeter–beacon tracker combination, a short-range altimeter–beacon tracker, and a short-range–interferometer beacon tracker all appear feasible. In each of the systems a common transmitter is used to generate the X-band signal and the 300 to 600 Mc signal. Also, it appears feasible to use a single antenna for the extended range altimetry and beacon tracking functions. E.E.B.

**N65-36582#** Texas A&M Univ., College Station.
**PULSE SHAPE DISCRIMINATION CONSIDERATIONS IN A DUAL CRYSTAL GAMMA-RAY SCINTILLATION DETECTOR**
Carroll F. Lam (Ph.D. Thesis) Aug. 1965 82 p refs
(Contract AF 33(608)-1120)
(AD-620395)

The use of a dual crystal/single photomultiplier scintillation detector system in conjunction with pulse shape discrimination techniques can reduce the Compton contribution to a gamma-ray spectrum from 20 to 70 percent. The system investigated in this research reduced the area under the entire Compton continuum up to 40 percent. Author

**N65-36587#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**AN OPTICAL SYSTEM USING MOIRE' PATTERNS TO OBTAIN QUANTITATIVE DATA IN A BOUNDARY LAYER**
James Maner Tonge (M.S. Thesis) Jun. 1965 46 p refs
(GAM-65B/ME/65-9; AD-620671)

The moire' technique is extended to the measurement of refractive index gradients in air. Moire' bands, produced by printers' screens and separated by an air space, are deviated by an index of refraction gradient. The deviation is shown to be directly proportional to the temperature and density gradients. Temperature gradients are measured along the vertical surface of a heated flat plate and compared with theoretical values. Measured values generally agree with theoretical values within 5%. Author

**N65-36635#** Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
**A DEVICE FOR MEASUREMENT OF CONTACT POTENTIALS USING DYNAMIC CONDENSATOR [PRIBOR DLYA IZMERENII KONTAKTNYKH POTENTSIALOV PO METODU DINAMICHESKOGO KONDENSATORA]**
Ryszard Henrych and Zdzislaw Kowalski May 1965 22 p refs
In RUSSIAN; ENGLISH summary
(Rept.-633/ZI/E) CFSTI: HC $1.00/MF $0.50

An electrometer for the measurement of contact potentials of metals and surface potentials of liquids in the range up to 1000 mV is described. The measurement is performed by the compensation of measured potential with known voltage. The apparatus is transistorized. Author

**N65-36663#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
**A STUDY OF RUBIDIUM VAPOR MAGNETOMETERS**
Joseph Clifford Giles (M.S. Thesis) Jun. 1965 79 p refs
(SP/PH/65-10; AD-616739)

The operational characteristics of a two-cell $Rb^{87}$ vapor magnetometer and a four-cell $Rb^{85}$ vapor magnetometer are investigated. Both instruments are found to have optimum operating temperatures of about 40°C. The two-cell magnetometer is found to have polar deadzones with widths of 48° and to have an equatorial deadzone with a width of 20°. The four-cell magnetometer is found to have a 23° equatorial deadzone. The magnetometers are shown to follow periodically varying fields with frequencies as high as 48 kc/s. The magnetometers are shown to follow transient field charges as large as 18.1K$\gamma$ occurring in times as small as three microseconds. Author

**N65-36672#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EXPERIENCE OF TRACKING WITH THE NAFA-3S/25 CAMERA**
A. G. Krylov 25 May 1965 10 p Transl. into ENGLISH from Byul. St. Optich Nablyudeniya Iskusstv. Sputnikov Zemli (USSR), no. 29, 1962 p 33–37
(FTD-TT-65-115/1+2; AD-618640)

Photographic recording of satellites from the Zvenigorod observation station is discussed and improvements to the camera installation and techniques are described. E.E.B.

**N65-36723#** General Aniline and Film Corp., Binghamton, N. Y. Photo and Repro Div.
**PHOTOPOLYMER PRINTER AND PROCESSOR Final Engineering Report, May 1963–Nov. 1964**
C. H. Jacobson Dec. 1964 42 p refs
(Contract DA-36-039-AMC-02292(E))
(AD-620187)

This report covers the design, development, and fabrication of a photopolymer printer and a processor for printing, chopping, processing, and drying positive transparency prints from processed aerial film, in 250-foot lengths by 5 inches wide, by means of a photopolymerization process. The report contains a description of the photopolymer printer processor, as delivered, and describes the various tests and design considerations in selection of a light source compatible with the characteristics of the polymer material; exposure method; various system resolution tests based on light source, exposure method and interval, and photopolymer materials; processing, washing, and drying methods; and the development of equipment to implement these operations. The report also contains operational theory relating to the use of photopolymer material for making positive transparency prints. The formula for the photopolymer coating, with mixing and coating procedures, is included. Author (TAB)

**N65-36735#** Air Force Cambridge Research Labs., Bedford, Mass. Aerospace Instrumentation Lab.
**EVALUATION OF THE T-755/GMQ-20 WIND SPEED AND DIRECTION TRANSMITTER Instrumentation Paper No. 69**
Russell M. Pierce, Jr. Jun. 1965 32 p refs
(AFCRL-65-444; AD-619171)

The paper presents the test objectives, procedures, and results of an evaluation of the T-755/GMQ-20 Wind Speed and Direction Transmitter. Electrical and wind tunnel tests were

performed to determine the operational capabilities of the T-755 when used in a typical operational wind-system configuration from which the AM-1806/GMQ Amplifier Assembly had been removed. Results revealed that the T-755 could drive up to 10 readouts, without being overloaded, under laboratory conditions. Restrictions and recommendations for calibration in a typical field configuration are presented. Author (TAB)

**N65-36778*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**A COMMANDABLE TAPE-RECORDER DELAY TIMER AND CLOCK SYSTEM FOR AE-B**
F. J. Kopetski and J. N. Libby Oct. 1965 23 p
(NASA-TM-X-55299; X-724-65-397) CFSTI: HC $1.00/MF $0.50 CSCL 14C

A system developed for the AE-B spacecraft will permit the delayed recording of any 4-minute orbital data sector. The delay is adjustable in 1-minute increments from 1 to 127 minutes. The selected time delay is made by presetting a delay timer through the command link. A clock is incorporated in the system to verify the preset commands and to record the time of data acquisition. This report describes the application of the system to the AE-B project and provides the circuit parameters for application to other projects. Author

**N65-36802#** Library of Congress, Washington, D. C. Aerospace Technology Div.
**SOVIET INFRARED SENSORS. II: PHOTON DETECTORS Surveys of Communist World Scientific and Technical Literature**
Charles Shishkevish 30 Sep. 1965 61 p refs
(ATD-P-65-80)

A survey based upon open-source Soviet scientific literature in the field of photon detectors is presented. Topics covered include: hot-electron effects as related to infrared photon counters; conduction in the impurity band due to optical transitions between impurity levels of germanium; and the optical photoelectric, and photoelectromagnetic properties of $CD_xHg_{1-x}Te$. G.A.L.

**N65-36817#** Smithsonian Astrophysical Observatory, Cambridge, Mass.
**TRANSMISSION COEFFICIENT OF THE BAKER-NUNN OPTICAL SYSTEM**
Fred D. Young and Karen Hebb 11 Oct. 1965 17 p refs
(Grant NSF GP-2999)
(SAO Special Rept.-187)

To determine analytically the transmission coefficient as a function of wavelength for a given lens system, the symmetry of the three-element corrector cell system in the Baker-Nunn satellite tracking camera was considered. An expression for the transmission coefficient was derived for optimum conditions of the glass, by determining the fractional absorption loss as a function of wavelength due to each glass element. It was then assumed that the transmission coefficient at any given wavelength was a fractional part of the light transmitted by the three elements as a system at that wavelength. To reduce chromatic aberration to zero at three distinct wavelengths, Schott KZFS-2 glass was used for the two outer elements; Schott SK-14 for the central element. The radiation path was not considered. Results show the transmission curve to be essentially flat at approximately 97% transmission from 5000 Å to 7000 Å. M.G.J.

**N65-36834#** Atlantic Research Corp., Alexandria, Va.
**RESEARCH AND DEVELOPMENT OF A CONTINUOUS ATMOSPHERIC MEASUREMENT SYSTEM Final Report, Dec. 1963–Dec. 1964**
Richard H. Johns and Alton M. Mc Kissick, Jr. Wright-Patterson AFB, Ohio, AMRL, May 1965 22 p
(Contract AF 33(615)-1383)
(AMRL-TR-65-75; AD-619378)

The application of electrolytic hygrometer cells for the measurement of atmospheric moisture and carbon dioxide was investigated. A carbon dioxide–moisture converter was devised. After system feasibility was proved, a laboratory model was built. Some difficulties were experienced with capillary electrolytic cells and flow control. The selection of optimum components is important. Author (TAB)

# 15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

**N65-35823#** Frankford Arsenal, Philadelphia, Pa. Research and Development Directorate.
**WELDING 2014-T6 AND 2024-T86 ALUMINUM ALLOY SHEET**
David E. Schillinger Mar. 1965 47 p refs
(R-1752; AD-615735)

The object of this work was to improve the mechanical properties of 2000 series aluminum alloy weldments. Major efforts were directed toward obtaining increased quenching rates and solidification rates in the weld beads and heat-affected zones, and minimization of heat-affected zone width under the premise that successful accomplishment of these ends would be beneficial to weldment mechanical properties. These effects were sought by preparing welds with minimum practicable energy inputs and, also, by precooling the materials to be welded to extreme subzero temperatures (−250° F). The effects of weld bead removal and post-weld natural and artificial aging were also evaluated. Author

**N65-35882#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**SPOT WELDING OF NIOBIUM**
V. L. Brishin and A. D. Grishina 4 Aug. 1965 7 p Transl. into ENGLISH from Tsvetn. Metal. (Moscow), no. 10, 1964, p 67-68
(FTD-TT-65-613/1+2+3+4; AD-619333)

The high activity of niobium at elevated temperatures with gaseous oxygen and nitrogen and the resultant problem of obtaining high quality welded joints with niobium are discussed. High quality welded joints can be obtained with niobium by spot welding or by seam welding in a medium of inert gases. A brief discussion is presented of experiments with spot welding of niobium ranging in thickness from 0.1 to 0.5 mm. E.E.B.

**N65-35907#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**DEVICE FOR DISTRIBUTION OF A LIQUID (GAS) AMONG SELF-CONTAINED OBJECTS**

R. G. Savashvili and G. V. Kukhchik 2 Aug. 1965 6 p Transl. into ENGLISH from Soviet Patent No. 166153 (Appl. No. 887028/40-23, 12 Mar. 1964) 2 p
(FTD-TT-65-772/1+2+4; AD-618904)

A device for distributing a liquid (gas) over self-contained objects (for example, in flying apparatuses), which contains a separator with outlets with a distributing disk placed in it with an input and a crossput channel, and which also has the distinguishing feature that for increasing the throughput capacity with the same dimensions and weight, the openings in the body and the channel in the distributing disk are designed in trapezoidal form. Author

**N65-35908#** General Electric Co., Lynchburg, Va. Communications Products Dept.
**MICROMINIATURE CRYSTAL UNITS CR-(XM-47)/U Quarterly Report, 1 Feb.–30 Apr. 1965**
John H. Sherman, Jr. [1965] 12 p
(Contract DA-36-039-AMC-02232(E))
(QR-7; AD-618488)

The redesigned header has been produced successfully. A weld schedule appropriate to all of the known available triode-gun electron beam welders has been devised. Laser welding has been shown to be a practical technique of closure for these envelopes, but no installation of equipment fixtured suitable for crystal work has been assembled. Author

**N65-35924#** Philco Corp., Blue Bell, Pa. Applied Research Lab.
**A FUNDAMENTAL STUDY OF EPITAXY BY FLASH EVAPORATION Final Report, 1 Oct. 1964–30 Mar. 1965**
John L. Richards 30 Apr. 1965 80 p refs
(Contract AF 19(628)-2937)
(AFCRL-65-412; AD-618909)

A study has been made of the conditions under which films of III-V compounds can be evaporated and deposited stoichiometrically onto a number of substrates. The crystalline nature and crystal quality of films of seven of the III-V compounds deposited onto Ge, $CaF_2$, and GaAs substrates have been studied with reference to changes in such parameters as evaporator and substrate temperature, lattice mismatch with substrate, and substrate orientation. Conditions have been determined for the preparation of epitaxial films. Films of mixed semiconductor systems can be deposited by the flash evaporation of mixed powders. A detailed study, using electron diffraction techniques, has been made of orientation and twinning effects in deposited GaAs films. A study has been made to determine more fully the nature of the solid solubility in mixed systems of the III-V compounds. A study has been made of the impurity doping of flash evaporated epitaxial films of III-V semiconductors. The germanium–germanium epitaxial system has been studied. An investigation has been made of the direct and indirect epitaxy of compound semiconductors on mica substrates. Author

**N65-35929#** Celanese Corp. of America, New York.
**RESEARCH AND DEVELOPMENT OF MANUFACTURING METHODS FOR PBI FIBERS AND FIBROUS STRUCTURES OF PBI YARNS Interim Progress Report, 8 May–8 Aug. 1965**
Thomas C. Bohrer, Anthony B. Conciatori, M. R. Livingston, Arthur E. Prince, Robert Rozett et al Wright-Patterson AFB, Ohio. AF Mater. Lab. [1965] 26 p
(Contract AF 33(657)-11232)
(IR-8-163(VIII); AD-618078)

The production of 650 pounds of drawn PBI yarn required under Phase I was completed during June. Overall average tensile properties of 4.9 grams/denier, 21% elongation and 115 grams/denier initial modulus exceeded target values. Optimum draw temperature for 50-filament yarn was established as 965° F, and additional temperature control equipment was installed to give greater yarn uniformity and higher drawing efficiency. Production of threads for Phase II is complete. Construction of parachute fabric is being optimized and experimental weavings of narrow fabrics are underway. Bids have been obtained for proposed sub-contracting of the weaving of narrow fabrics. It is planned to complete Phase II during the next three months, with the exception of the extended time tests. Delivery of the large reactor needed for Phase III polymerization has been delayed by a strike. The production of 750 pounds of drawn yarn from Phase III polymer also will be somewhat delayed. Author

**N65-35984#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ULTRASONIC FLAW DETECTOR**
V. I. Starokol'tsev, D. V. Kostyukov, and A. V. Malinka 30 Mar. 1965 4 p Transl. into ENGLISH from Soviet Patent no. 155317 (Appl. no. 781246/25-8, 1 Dec. 1964) 2 p
(FTD-TT-65-135/1+2; AD-614397)

For increased accuracy in ultrasonic detection of flaws in welded tube seams, a flaw detector has been developed for carrying out control both by the shadow and the echo method simultaneously. The detector described contains two emitters with obliquely placed piezoelements symmetrically located on both sides of the seam being examined. A switching device is incorporated for periodic, alternate switching of the piezoelements as emitter or receiver of the ultrasonic oscillations; this operates in such a way that each piezoelement detects both its own reflection from the seam, and a direct signal passing from the other piezoelement through the seam being tested. A schematic drawing of the device is included. M.G.J.

**15**

**N65-35991#** Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Accessories Div.
**PARAMETRIC STUDY ON THE ROLLER GEAR REDUCTION DRIVE**
A. L. Nasvytis and J. E. Bauer Ft. Eustis, Va., Army Aviation Mater. Labs., Jun. 1965 105 p ref
(Contract DA-44-177-AMC-30(T))
(ER-5637; USAAVLABS-TR-64-29; AD-619294)

This report covers the parametric study of the roller gear drive to determine its applicability to current or projected Army helicopters. The basic principles used in the roller gear drive are presented. The results of a study to determine the weight, volume, and outside diameter as a function of ratio (from 20:1 to 100:1) and horsepower (from 250 to 4,000) are included. Other features, such as reliability, efficiency, life, vibrations, and cost are discussed. Author

**N65-36015** Naval Avionics Facility, Indianapolis, Ind.
**NUMERICAL CONTROL RELATED TO THIN FILM CIRCUIT FABRICATION**
G. R. Stutzman *In* ONR Automation and the Navy [1964] p 1–12 (See N65-36014 24-08) CFSTI: $3.00

A process which utilizes a numerically-controlled milling machine to produce a low cost graphite mask for thin film circuit fabrication is described. This process results in a faster delivery of circuits for microelectronic modules. C.T.C.

**N65-36023#** Sylvania Electric Products, Inc., Woburn, Mass. Semiconductor Div.
**PRODUCTION ENGINEERING MEASURE (PEM) FOR SILICON VARACTOR DIODE Quarterly Progress Report, 29 Mar.–30 Jun. 1965**

G. Bowne and R. Bayliss [1965] 65 p
(Contract DA-36-039-AMC-06159(E))
(QPR-1; AD-619663)

The first engineering test sample run for improving production techniques in the fabrication of a silicon varactor diode, in order to approach the reliability goals called for in specifications for the diode, was completed. The information gained from test results will be used to modify the design, fabrication, and screening techniques for the next cycle. A total of four cycles are planned. A diagram of the program plan is given, and distribution graphs and histograms on various diode parameters such as reverse current, junction capacitance, cutoff frequency, breakdown voltage, and thermal resistance are presented. L.S.

**N65-36026** Hanford Atomic Products Operation, Richland, Wash.

**AN IMPROVED METHOD OF ETCHING BY ION BOMBARDMENT**

T. K. Bierlein and B. Mastel *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 1–7 refs (See N65-36025 24-17) CFSTI: $5.00

Two applications of etching by ion bombardment are described: (1) etching of refractories and cermets, and (2) etching of metals. In the first case, the electrical nonconductors are made conductive by virtue of a surface coating of metal sputtered from a metal gauze covering the specimen; subsequent etching and redeposition in etching of the specimen surface. In the second case, UHF excitation is used to permit high etching rates at extremely low gas pressures. The equipment, methods, and results achieved are discussed. Author

**N65-36029** Bridgeport Brass Co., Conn.

**DECREASING THE ELECTROPOLISHING TIME FOR URANIUM**

L. Robins and M. F. Garufi *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 27–35c (See N65-36025 24-17) CFSTI: $5.00

The behavior of mechanically polished uranium was studied during electropolishing to determine the times for preparing satisfactory metallographic samples. Specimens suitable for preferred orientation and microstructural examinations were obtained after 10-minutes in an orthophosphoric acid-ethyl alcohol-ethylene glycol solution, and after about 1.0 minute in a chromic-acetic acid solution. Evaluations were based on X-ray diffractmetric and microscopic observations. Author

**N65-36032** Battelle Memorial Inst., Columbus, Ohio.

**METALLOGRAPHIC PREPARATION OF IRRADIATED URANIUM CARBIDE**

A. A. Bauer and F. E. Mc Grath *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 77–85 ref (See N65-36025 24-17) CFSTI: $5.00

Uranium carbide is extremely susceptible to corrosive attack by water and moist air. This creates a problem in the hot-cell metallographic preparation of irradiated material, since water alone cannot be used as the abrasive vehicle in vibratory polishing. A solution of 2 per cent chromium trioxide in water was found to provide a satisfactory suspension and polishing medium, although its use for badly cracked specimens is not recommended. Water formed during preparation of plastic replicas also presents a problem in the hot cell. This can be overcome by using methyl acetate as the solvent in preparing cellulose acetate replicas and by desiccating the specimen and replica immediately after application. Author

**N65-36036** Los Alamos Scientific Lab., N. Mex.

**SOME PRELIMINARY METALLOGRAPHIC STUDIES OF MATERIALS FOR USE ABOVE 2500°C**

C. G. Hoffman *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 137–148 (See N65-36025 24-17) CFSTI: $5.00

Nuclear rocket engines require materials capable of operating at temperatures in excess of 2500° C. Little is known of such materials, including their metallography. A few preliminary studies of materials such as the refractory metal carbides and other high melting materials are presented in this paper, including metallographic preparation, examination and microhardness determinations. Author

**N65-36074#** Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.

**A PROTECTIVE COATING SYSTEM FOR TZM ALLOY REENTRY VEHICLE**

Milton Levy Jul. 1965 19 p refs
(ARMA-TR-65-19; AD-618935)

An electroplated coating system was developed to protect a TZM alloy reentry vehicle from oxidation at high temperatures. The coating system, comprised of an undercoating of 0.0005 inch chromium, an intermediate coating of 0.001 inch nickel, and an outer coating of 0.0005 inch chromium, was adherent, oxidation resistant, and thermal-shock resistant, and was compatible with the experiment requirements. Author

**N65-36076** Argonne National Lab., Ill.

**METALLOGRAPHY—ALLY OF NONDESTRUCTIVE TESTING IN EVALUATING NUCLEAR FUEL COMPONENTS**

C. H. Bean and W. J. Mc Gonnagle *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 1-21 refs (See N65-36075 24-17) CFSTI: $6.00

A discussion is presented on the use of metallography with nondestructive testing in evaluating nuclear fuel components. It is shown that metallography is useful in locating microporosity and shrinkage in thick uranium base alloy castings; in establishing non-bond and degrees of bond to separate satisfactory and unsatisfactory bonded interfaces in reactor fuels; in detecting small discontinuous inclusions in cladding stock; in classifying metallographic structure of compound phase in rolled plates of Al–U alloy; in detecting microcracks, grain size, and heat treatment in unalloyed uranium slug material; in locating internal diameter microcracks in small diameter zirconium alloy tubing, and in examining the internal crystal and grain structure in metals. R.N.A.

**N65-36078** Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

**MEASUREMENT OF THE THICKNESS OF ALUMINUM OXIDE FILM**

L. P. Costas and E. C. Hoxie *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 26-35 (See N65-36075 24-17)
(Contract AT(07-2)-1) CFSTI: $6.00

Two methods of measuring the corrosion product thickness of aluminum oxide film are described. In the first method, the aluminum oxide film thickness is determined by metallographic examination of cross sections. In the second, the thickness is determined by an optical method, a refinement of the Kapernick method. Advantages and disadvantages for each technique are discussed. R.N.A.

**N65-36079** Oak Ridge National Lab., Tenn.
**PRELIMINARY EVALUATION OF A NEW POLISHING CLOTH**
R. S. Crouse *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 36–44 ref (See N65-36075 24-17) CFSTI: $6.00

A new type of commercial polishing cloth has recently been evaluated by the metallography group of the metallurgy division at the Oak Ridge National Laboratory. The cloth was tested using vibratory and hand polishing methods with several metals and alloys. The polishing action provided is quite rapid and reduces the time for the primary polishing step by about fifty percent. It was not suitable for polishing aluminum nor for final polishing with Linde B abrasive. The cloth is not as universally applicable as nylon or silk but definitely has a place in metallographic operations. Author

**N65-36088** Battelle Memorial Inst., Columbus, Ohio.
**HOT CELL METALLOGRAPHIC EXPERIENCE AT BATTELLE**
F. E. Mc Grath and A. A. Bauer *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 134–156 (See N65-36075 24-17) CFSTI: $6.00

During the operation of the Battelle hot cells, a wide variety of irradiated structural, control, and fuel materials were examined. The metallographic procedures are outlined to illustrate the applicability of the procedures and techniques employed. Typical results achieved with various materials are shown. Observed affects of irradiation are noted. Photomicrographs of structural, control, alloy fuel, and dispersion and ceramic fuel materials are included. R.N.A.

**N65-36089** Oak Ridge National Lab., Tenn.
**A REMOTE METALLOGRAPHIC SPECIMEN GRINDER**
E. L. Long, Jr., A. E. Richt, D. L. Holcomb, and R. J. Gray *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 157–162 (See N65-36075 24-17) CFSTI: $6.00

An investigation is currently under way to evaluate potential methods of remotely grinding metallographic specimens and to select optimum equipment. During this investigation several commercial grinders have been considered, none of which could be placed in-cell as purchased. As a result, one grinder has been selected and modified for remote grinding. Author

**N65-36091** Oak Ridge National Lab., Tenn.
**EXPERIENCE WITH VIBRATORY POLISHERS AND DESIGN FOR HOT-CELL APPLICATION**
E. L. Long, Jr., R. J. Gray, and J. T. Meador *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 184–188 refs (See N65-36075 24-17) CFSTI: $6.00

A discussion is presented on experience with vibratory polishers in preparing specimens for metallographic examination and their design for application to new metallographic hot cells. Newly developed polishing techniques for aluminum, aluminum alloys, beryllium, beryllium alloys, mutlimetallic mounts such as beryllium and stainless steel, uranium, and uranium carbides are discussed. A brief mention is made of slurry preparations. R.N.A.

**N65-36092** Argonne National Lab., Ill.
**REMOTE METALLOGRAPHIC PREPARATION OF IRRADIATED ALUMINUM-CLAD LEAD-BONDED CERAMIC FUEL PELLETS**
R. Carlander *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 189–197 (See N65-36075 24-17) CFSTI: $6.00

Irradiated aluminum-clad lead-bonded thoria–26w/o urania Borax-IV fuel pellets which had been irradiated to 30,000 MWD/T were prepared for metallographic processing by sectioning on an abrasive cutoff machine and by mounting in cold-setting plastic. Extreme care was exercised in the grinding operations to insure particle retention by the mounting material. The samples were ground through 600-grit silicon carbide papers and polished, successively, on silk cloths impregnated with 3- and 1-micron diamond abrasive. The samples were final-polished with 1/4-micron diamond compound on microcloth. This procedure is convenient in that it is also used for uranium and its alloys. Results of this polishing technique are considered quite good, especially taking into account the wide variation in hardness of the materials contained in the fuel plate composite. Author

**N65-36093** Oak Ridge National Lab., Tenn.
**METALLOGRAPHY OF PYROLYTIC CARBON COATED AND UNCOATED URANIUM CARBIDE SPHERES**
C. K. H. Du Bose and R. J. Gray *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 198–237 refs (See N65-36075 24–17) CFSTI: $6.00

Techniques have been developed for the metallographic preparation and examination of carbon-coated and uncoated uranium carbide particles both in the unsupported condition and as-fabricated into graphite matrices. The particle coatings studied were deposited pyrolytically from a hydrocarbon gas, producing two morphological types of pyrolytic carbon coatings. In one type, the coating is smooth on the outer surface and a cross-sectional plane exhibits a laminar onion-ring type structure, while in the other type, the surface has a pebble-like finish with the cross section exhibiting a columnar or conical grain structure. The microstructures of the carbide particles show variations in the amount of UC and $UC_2$ with an average ratio of approximately 70% $UC_2$ and 30% UC. Heat treatments above 1800° C may produce uranium oxides at the particle-coating interface. Author

**N65-36161#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PROBLEMS OF TECHNICAL PROGRESS IN MACHINE CONSTRUCTION OF THE REPUBLIC**
S. Minasyan 24 Aug. 1965 12 p Transl. into ENGLISH from Promy. Armenii (Erevan), no. 2, 1962 p 7–10
(FTD-TT-65-438/1+4; AD-620766)

The basic problems of technical progress in machine construction in the Soviet Union are discussed and the application of plastics, synthetic materials, electronics, computers, and nuclear radiation techniques in the machine construction industry is reviewed. Advantages and disadvantages of plastics over metals and metal alloys in machine design and construction are discussed. Also, the use of gamma radiation in the inspection and examination of materials and the use of radioactive isotopes for defect detection and measurement in industry are considered. E.E.B.

**N65-36188#** Rotron Mfg. Co., Woodstock, N. Y.
**THE DEVELOPMENT OF A GAS LUBRICATED BEARING BLOWER ASSEMBLY FOR USE IN AN AN/TED-9 RADIO TRANSMITTER Interim Development Report, 3 May–3 Aug. 1965**
1 Sep. 1965 27 p refs
(Contract NObsr-87522)
(AD-620269)

Investigations of the modes of instability of plain cylindrical journal gas bearings were conducted and the results are

presented. The continued development of a converter driven blower using self acting gas bearings for use in an AN/TED-9 Transmitter is described. Author

**N65-36189#** Army Electronics Labs., Fort Monmouth, N. J. Mechanical Engineering Branch.
**EXPERIMENTAL MAST SECTION JOINT DEVELOPMENT**
William J. Librizzi and Richard L. Johnson Jan. 1965 23 p
(ECOM-2611; AD-620140)

A study was made using four specimen joints of a fast-lock sleeve design. The joining techniques used were welding, and epoxy bond. The epoxy use was varied; the method of application was varied; and the amount of heat and/or pressure used to distribute the epoxy was varied. The study was extended to include tests of the production joint from Mast AB-577/G. These test results are compared. Author

**N65-36192#** Southwest Research Inst., San Antonio, Tex.
**LOAD-CARRYING CAPACITIES OF GEAR LUBRICANTS OF DIFFERENT CHEMICAL CLASSES BASED ON RESULTS OBTAINED WITH WADD HIGH-TEMPERATURE GEAR MACHINE USED WITH INDUCTION-HEATED TEST GEARS Technical Report, Mar. 1960–May 1964**
G. A. Beane, IV (AF Aero Propulsion Lab.) and C. W. Lawler Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Apr. 1965 44 p refs Prepared jointly AF Aero Propulsion Lab. (Contract AF 33(616)-7223; AF 33(657)-9248; AF 33(657)-11028)
(AFAPL-TR-65-23; AD-620294)

The WADD High-Temperature Gear Machine and its operation are described briefly. The procedures used with the machine are shown to provide a realistic means of evaluating and screening lubricants for use in aircraft turbine engines operating at elevated gear and lubricant temperatures. A cross section of oils representing different chemical classes of lubricants was used with the WADD High-Temperature Gear Machine in conjunction with induction-heated test gears. The influence of gear material on load-carrying capacity of gears was studied by using two different steel compositions. Also, the effect of gear temperature on load-carrying capacity was investigated at temperatures up to 700° F. The data generated on the WADD High-Temperature Gear Machine, when compared with that generated on the Erdco Ryder Gear Machine, indicated that the rates obtained were comparable. When using Standard Ryder gears (AMS 6260) and gears made of a high-temperature gear material (Nitralloy-N steel), the load-carrying capacity of a lubricant could not be predicted adequately by using as test gears those composed of an alloy that was different from the alloy that would be used for the intended application. All of the lubricants evaluated when Nitralloy-N steel test gears were used demonstrated a decrease in load-carrying capacity with increasing gear temperature up to about 400° F. Author (TAB)

**N65-36218#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**POSSIBLE APPLICATION OF THE ELECTRON GUN IN DRILLING ON THE MOON**
J. D. Halajian May 1965 18 p refs
(RM-277)

A preliminary experimental attempt is made to assess the electron gun as a device to perform drilling, cutting, and other operations on the moon and in outer space. Judging from the test results, the technique appears to be feasible and merits further investigation because of a number of advantages it seems to offer over conventional techniques and some considerations imposed by the nature of the lunar surface and environment. Author

**N65-36263#** Westinghouse Electric Corp., Pittsburgh, Pa. Research Labs.
**DEPOSITION OF SILICON ON INSULATING SUBSTRATES Final Report, 1 Jul. 1964–30 Jun. 1965**
T. L. Chu, M. H. Francombe, G. A. Gruber, J. J. Oberly, and R. L. Tallmann 27 Jul. 1965 98 p refs
(Contract AF 19(628)-4220)
(AFCRL-54-574; AD-619992)

The pyrolysis of silane and the vacuum evaporation of silicon have been used for the deposition of silicon films on various substrates, with one objective being to minimize autodoping and diffusion effects. The substrates included {111} oriented silicon, {001} oriented alpha-silicon carbide, {001} oriented sapphire, {111} oriented lanthanum aluminate, {110} oriented spinel, {111} oriented thorium dioxide, {001} oriented zircon, and also silicon nitride and thorium dioxide films. Epitaxial growth of silicon was achieved in many cases. The nucleation, growth, and perfection of silicon films on silicon carbide substrates by the pyrolytic technique were studied in detail, and the films were found to comprise crystals of {111} and {110} epitaxial orientations. A masking technique was used to control the nucleation and growth of silicon films on silicon carbide substrates. The preparation of new substrate materials, such as silicon nitride, thorium dioxide, and yttrium oxide, in the form of films deposited on silicon and other substrates was attempted. Author

**N65-36286#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**METHODS OF TESTING COMPONENTS AND MATERIALS OF MACHINES AND INSTRUMENTS, ISSUE I**
28 Jan. 1965 35 p refs Transl. into ENGLISH of selected articles from the book "Methods of Testing Components and Materials of Machines and Instruments, Issue I" Moscow, Gosatomizdat, 1961 p 17–46
(FTD-MT-64-247; AD-612763)

CONTENTS:

1. QUESTION ABOUT SELECTION OF MATERIALS FOR OPEN-TOOTHED TRANSMISSIONS WORKING WITHOUT LUBRICANT IN AGGRESSIVE MEDIA T. T. Belousova and S. F. Fonarev p 1–13 refs (See N65-36287 24-15)

2. EXPERIMENTAL INVESTIGATION OF ANTIFRICTION PROPERTIES OF CARBON AND GRAPHITE BASE MATERIALS WORKING IN CONDITIONS OF DRY FRICTION S. F. Fonarev, A. A. Kul'bakh, and V. A. Dzhonson p 14–20 (See N65-36288 24-15)

3. INVESTIGATION OF ANTIFRICTION PROPERTIES OF MATERIALS BASED ON GRAPHITE OF BRANDS AG1500-B83 AND AG1500-CU, WORKING IN CONDITIONS OF DRY FRICTION S. F. Fonarev, A. A. Kul'bakh, and V. A. Dzhonson p 21–31 ref (See N65-36289 24-15)

**N65-36287** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**QUESTION ABOUT SELECTION OF MATERIALS FOR OPEN-TOOTHED TRANSMISSIONS WORKING WITHOUT LUBRICANT IN AGGRESSIVE MEDIA**
T. T. Belousova and S. F. Fonarev *In its* Methods of Testing Components and Mater. of Machines and Instr. 28 Jan. 1965 p 1–13 refs (See N65-36286 24-15)

Impregnation of graphitized material by babbitt is shown to improve antifriction properties when tested in a special instrument which permits the determination of moment and coefficient of friction as well as wear of materials of friction pairs in a wide range of speeds and loads. Babbitt-impregnated graphite material can only be used when temperature of insert

heating does not exceed 220° C. A copper-impregnated material is found to be unsuitable because of the heterogeneity of its structure and the resultant instability of antifriction properties. M.W.R.

**N65-36288** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EXPERIMENTAL INVESTIGATION OF ANTIFRICTION PROPERTIES OF CARBON AND GRAPHITE BASE MATERIALS WORKING IN CONDITIONS OF DRY FRICTION**
S. F. Fonarev, A. A. Kul'bakh, and V. A. Dzhonson *In its* Methods of Testing Components and Mater. of Machines and Instr. 28 Jan. 1965 p 14–20 (See N65-36286 24-15)

Selection of materials for low-speed open gear transmissions operating without lubrication in aggressive media is considered. When comparative tests were made of cylindrical rollers from various stainless steels and a chrome cast iron, the best combination was a steel on steel (designated as Kh 18) with hardness of working surfaces of teeth equal to 55-60. Allowed pressure per unit length of tooth at peripheral wheel velocity $v \leq 0.3$ m/sec was $\approx 70$ kg/cm. Other steel combinations are recommended for short periods of service at this velocity; for these, hardnesses of working surfaces of teeth are found to be about 48 and 50 and allowable pressures are 40 kg/cm and 50 kg/cm. Chrome cast iron on steel or on chrome cast iron as well as another combination steel were not recommended for open gear transmissions working without lubricant. M.W.R.

**N65-36289** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**INVESTIGATION OF ANTIFRICTION PROPERTIES OF MATERIALS BASED ON GRAPHITE OF BRANDS AG1500—883 AND AG1500-CU, WORKING IN CONDITIONS OF DRY FRICTION**
S. F. Fonarev, A. A. Kul'bakh, and V. A. Dzhonson *In its* Methods of Testing Components and Mater. of Machines and Instr. 28 Jan. 1965 p 21–31 ref (See N65-36286 24-15)

Carbon-graphite materials in the form of semirings were tested at normal and forced operating conditions for resistance to wear, establishment of temperature rates, and determination of coefficient and moment of friction. A graphitized material (designated brand 15E) without lead impregnation was found to be satisfactory in pair with stainless steel at specific pressures up to 20 kg/cm$^2$; coefficient of friction did not exceed 0.27 (slip speed v = 0.3 m/sec). Antifriction properties are improved significantly by impregnation with lead, and the wear of inserts does not change and does not exceed 0.66 mg/cm$^2$/hr. Preliminary fitting of inserts must be at specific pressures of 15 to 20 kg/cm$^2$; but the lead impregnated graphitized material can be used at specific pressures of more than 30 kg/cm$^2$. Impregnation of a brand 15D carbon does not materially improve its antifriction properties. During work of a pair with carbon-graphite inserts, wear of steel rollers is minute and has practically no effect on efficiency. M.W.F.

**N65-36349#** College of Aeronautics, Cranfield (England). Dept. of Production and Industrial Administration.
**THE DESIGN OF A PNEUMATIC TAPE READER, PAPER E4**
C. J. Charnley, R. E. Bidgood, and S. Ramanathan [1965] 11 p refs Presented at 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assoc. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

The commencement of a program to design a sequentially controlled drilling machine has resulted in the need for a pneumatic tape reader. The reader is designed for a 5 track standard tape and the tape feed is achieved by pneumatic means. Fluid logic devices are used as buffer stage and the paper deals with the specific problems which arose in designing such a unit. It is shown that the passage of air through holes in a punched tape could be made use of to obtain an output signal of the binary coded decimal form. Author

**N65-36378#** Aeronautical Research Labs., Melbourne (Australia).
**THE DESIGN OF A HIGH TEMPERATURE RIG TURBINE**
L. A. Mc Gee and A. S. Finlay Jun. 1964 45 p refs
(ARL/ME-114) CFSTI: HC $2.00/MF $0.50

The design of a gas turbine facility is described, the operating design point being chosen to comply with the requirements of a program to evaluate the use of chromium base alloys in turbine blades. The turbine is designed to operate with uncooled blades at 1400° K entry temperature, with blades stresses up to 10 tons/sq. in. The single stage rotor is attached to an "Adder" wheel carrier, bearing and shaft, and coupled to a cropped "Derwent" compressor to absorb power. Plant air is supplied to the single axial combustor at 8.72 lb/sec., turbine entry pressure is 22.61 psia. Impingement air cooling arrangements of entry cone and nozzle vanes are described. The turbine has been operated up to design speed (13560 rpm) cold, using blades of Nimocast 242, and hot up to 850° C and 9200 rpm. Author

**N65-36442*#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**THE EFFECT OF BAFFLES ON TANK SLOSHING, PART I**
Richard G. Schwind, Richard S. Scotti, and Jörgen Skogh Dec. 1964 154 p refs
(Contract NAS1-4065)
(NASA-CR-67426; LMSC-A642961) CFSTI: HC $5.00/MF $1.00 CSCL 13K

Three types of flexible baffles, cantilevered flexible, hinged, and slamming baffles were tested by subjecting the baffle to a sinusoidal velocity variation in water far from the free surface. Energy losses were obtained, made dimensionless as the loss coefficient, as a function of the flexibility and period parameter. The hydrogen bubble technique was developed and used to visualize the flow about the baffle. Two distinct flow regimes were observed. A 700 ft 16mm silent motion picture of the flow visualization has been made as part of this report. Six printed sections of this movie have been analyzed by tracing baffle tip and vortex center positions. The cantilevered flexible baffle has an optimum flexibility for maximum loss coefficient, normalized by the loss coefficient of the rigid baffle. The optimum flexibility and normalized loss coefficient both increase with decreasing period parameter. The data for this type baffle has been fitted with an empirical equation and used to determine the baffle efficiency for circular tanks with axisymmetric and lateral slosh, and rectangular tanks with lateral slosh. At a period parameter of 2, the baffle with optimum flexibility is 10 times more efficient than a baffle which is nearly rigid. Author

**N65-36450#** Grumman Aircraft Engineering Corp., Bethpage, N. Y.
**INVESTIGATION OF RELIABILITY MEASUREMENT BY VARIABLES TEST-TO-FAILURE**
J. J. Bussolini May 1964 98 p refs
(ADR-09-14-64.1)

This report describes the results of an investigation to determine the feasibility and validity of using overstress test-to-failure techniques as a means of reliability measurements or

as a reliability indicator for electronic equipment. The conclusions drawn from the program contained in this report indicate the usefulness of test-to-failure techniques as a tool for quantitative reliability measurement, weak link analysis and as a method for determining safety margins and performing prequalification reliability tests. The purpose of the test is to provide an indication of a product's ultimate strength early in its development stages. This program represents an advancement in the state-of-the-art in reliability testing in that a concept which had previously only been discussed and written about was studied, analyzed, and actually implemented in the form of an actual test on an item of modular electronic equipment taken from the E-2A aircraft. An unexpected proof by implication was developed from test results showing that the environmental limits anticipated in the aircraft were below those actually experienced. Author

**N65-36481#** Cornell Univ., Ithaca, N. Y. Materials Science Center.
**SOME COMMENTS ON ACID-SAW TECHNIQUES**
R. H. Geiss, W. G. Lehmann, M. Meistrich, R. W. Rollins, and J. Silcox 11 Dec. 1964 7 p refs *Its* Rept.-295
(Contract AT(30-1)-3029)
(NYO-3029-2; NYO-3087-2)

Acid sawing provides a means of cutting single crystals without substantial deformation. The saw designed by Young and Wilson, was modified for improved operation. The cut surfaces of a sawed Ni bar are illustrated. NSA

**N65-36500#** Hughes Aircraft Co., Culver City, Calif. Services Div.
**DIAPHRAGMS A Selected Bibliography**
J. Seremak Oct. 1965 14 p refs
(LS-BIB-65-1)

This selective bibliography contains 135 references on design and manufacture of metallic diaphragms including a complete search on bursting diaphragms. The bibliography covers period from 1920 to 1965, and includes unclassified reports and titles from open literature. Author

**N65-36512#** Pratt and Whitney Aircraft, Middletown, Conn.
**DIRECT CURRENT ELECTROMAGNETIC PUMP ANALYSIS**
J. H. Mc Conville 8 Jul. 1965 19 p refs
(Contract AT(30-1)-2789)
(TIM-929)

The two pass direct current electromagnetic pump is evaluated and an analysis is presented for the development of a computer program to be used in the pump design. Theory of operation, electric current distribution, and magnetic field and pressure considerations are covered. E.E.B.

**N65-36527#** Sandia Corp., Albuquerque, N. Mex.
**CLEANING METHODS FOR SEMICONDUCTOR AND THIN-FILM TECHNOLOGY**
J. D. Williams and J. N. Shafer Aug. 1964 15 p refs
(Contract AT(29-1)-789)
(SC-TM-64-963)

The various ways in which materials used in the fabrication of semiconductor and thin-film devices may become contaminated are presented. Procedures of removing and detecting this contamination are reviewed. By the use of the indium test of surface cleanliness we have been able to differentiate between various cleaning procedures which all yielded the highest indication of cleanliness by the steam and water break tests. Author

**N65-36592#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**METHOD OF DIFFUSION BONDING IN A VACUUM**
N. F. Kazakov, A. V. Krivoshey, and Ye. G. Sudenkov 13 Aug. 1965 4 p Transl. into ENGLISH from Soviet Patent no. 163874 (Appl. no. 796663/25-8, 19 Sep. 1962) 1 p
(FTD-TT-65-637/1+4; AD-620774)

A method of diffusion welding in a vacuum which has the distinguishing feature that, for the purpose of intensifying the diffusion processes, there is accomplished a cyclic raising and lowering of the temperature of heating of the material within the limits of ±30 to 100° C above and below the temperature of the phase transformation, keeping within the limiting temperatures and repeating this cycle until one is sure of phase transformation of not less than 10 to 20% of the grain of the alloy in the course of each cycle. Author

**N65-36656#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**OPTIMUM FORM OF INDUSTRIAL VACUUM PUMP EJECTORS**
S. I. Vil'der and B. V. Markachev 6 Jul. 1965 11 p refs Transl. into ENGLISH from Khim. Mashinostr. (USSR), no. 5, 1961 p 10–13
(FTD-TT-65-681/1+2+4; AD-617660)

To meet the need of refineries for unified vapor ejector vacuum pumps, tests were conducted to determine optimum configurations for ejector elements. Details are given on the construction of the test stand, which consisted of four industrial ejectors between which displacement condensers were placed. Tables list the values of individual geometric parameters of several industrial ejectors; the maximum test values established for the experiment; and the experimentally obtained optimum values of each parameter. The effects of nozzle and diffuser working surface purity, and of displacement of nozzle and diffuser axes on the operation were also investigated. Comparative characteristics are graphed, and a schematic showing the optimum ratios of ejector dimensions is included. M.G.J.

**N65-36760*#** National Aeronautics and Space Administration, Washington, D. C.
**PREPARATION AND USE OF NIOBIUM CARBIDE ARTICLES [IZGOTOVLENIYE I PRIMENENIYE IZDELIY IZ KARBIDA NIOBIYA]**
O. P. Kolchin and I. K. Berlin Oct. 1965 19 p refs Transl. into ENGLISH from Poroshkovaya Met., Akad. Nauk Ukr. SSR (Kiev), no. 4, 1965 p 25–34
(NASA-TT-F-9723) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Two variants are presented of the method of manufacturing from niobium carbide large-dimension parts for use chiefly as heaters and other furnace parts. An experimental industrial high-temperature induction vacuum furnace was tested, having heaters and screens made of niobium carbide. The height of the working space of the furnace was 1.3 m, the inner diameter 0.25 or 0.18 m. The heaters and screens were tested at temperatures up to 2,770° K, and it was shown that it is possible in principle to use parts made of niobium carbide in industrial high-temperature induction vacuum furnaces. The authors show that it is possible to raise the working temperature of furnaces with graphite heaters by applying carbide coatings to them or using screens made of niobium or tantalum carbide. Author

N65-36766*# Midwest Research Inst., Kansas City, Mo.
**EXTREME VACUUM TECHNOLOGY DEVELOPMENTS**
Paul J. Bryant, Charles M. Gosselin, and William W. Longley, Jr. Washington, NASA, Nov. 1965 48 p refs
(Contract NASr-63(06))
(NASA-CR-324) CFSTI: HC $2.00/MF $0.50 CSCL 13H

Several phases relating to the attainment, measurement, and application of ultrahigh vacuum environments are reported. The phases covered are: development of a dual expansion nozzle for vapor-jet studies; determination of the gases present in uhv systems with oil diffusion and getter-ion pumping; measurements and theory on cryopanel operation; establishment of cold welding criteria; and determination of response characteristics for extreme high vacuum gauges and field emission microscopes. A vapor nozzle with dual expansion chambers was designed. An analysis of the gas species present in a uhv system with getter-ion and oil diffusion showed many interesting comparisons. An important discovery was made regarding the operation of traps above oil diffusion pumps. A combined cryogenic and chemical trap showed the ability to give more reliable and economical service. The response of magnetron gauges in their original form and with a cesiation treatment is also reviewed. Numerous data have shown that a characteristic break from linearity and cutoff level exists for magnetron gauges, and that the pressure values at which these characteristics occur can be lowered by a cesiation treatment. R.W.H.

N65-36775*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**VAPOR DEPOSITED GOLD THIN FILMS AS LUBRICANTS IN VACUUM ($10^{-11}$ mm Hg)**
T. Spalvins and D. H. Buckley Washington, NASA, 1965 23 p refs Presented at 12th Ann. Vacuum Symp., Am. Vacuum Soc., New York, 29 Sep.–1 Oct. 1965
(NASA-TM-X-52125) CFSTI: HC $1.00/MF $0.50 CSCL 13H

Gold thin films of 1800 Å to be used as lubricants were vapor deposited on Ni, Ni–Cr and Ni–Re substrates. Strong bonding (adhesion) and durability between the film and substrate were found to be essential when thin films are used as a lubricant. Factors which were investigated included the selection of the film and substrate material. Strong durability of the thin film is directly related to the type and structure of the interfacial region. Two methods of substrate preparation prior to vapor deposition were investigated: (1) mechanically polished surface and (2) electron bombarded surface. Gold was vapor deposited on the mechanically polished surface at room temperature and on the thermally etched surface at an elevated temperature approximately (800° F). Strength and durability of the films were investigated in sliding friction experiments with a hemispherical niobium rider sliding on the films at a velocity of 5 feet per minute. Results obtained in these friction experiments indicated that the film endurance life was considerably better on the thermally etched surface. This increased film durability with the thermally etched surface is believed to be due to the formation of a diffusion type interface between the film and the substrate. Author

N65-36777*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**THE EFFECT OF GOLD PLATING ON SOLDERED CONNECTIONS**
S. D. Ebneter 15 Oct. 1965 38 p refs
(NASA-TM-X-5335) CFSTI: HC $2.00/MF $0.50 CSCL 13H

This report describes an investigation to determine the effects of gold plating on solder connections. A 3 × 3 × 6 factorial experiment was performed and the data were evaluated by an analysis of variance. The thickness of gold plating was shown to have a significant effect on the strength, metallic structure, and visual appearance of the solder connection. Analysis of a study to determine plating-solder, plating-operator, and solder-operator interaction revealed that only solder-operator interaction was significant. The report concludes that thin layers of gold plating are not detrimental to solder connections. However, tests did not definitely establish that thin layers of gold plating act as a protective coating. Additional testing should be performed to: (a) determine the effectiveness of gold plating in regard to plating thickness, (b) establish limits on process control, and (c) determine possible substitutes for gold plating as a protective coating. Author

N65-36805# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
**A SPECIAL METALLOGRAPHIC TECHNIQUE FOR PLUTONIUM: ELECTROLYTIC SWAB ETCHING**
R. L. Greeson, W. L. Johns, and R. J. Jackson 1 Oct. 1965 17 p refs
(Contract AT(29-1)-1106)
(RFP-543) CFSTI: $1.00

A metallographic technique employing electrolytic swab etching for the structural delineation of plutonium and its alloys is described. Also presented is a discussion of the etching solutions and conditions along with photographic results which indicate the applicability of the method. Author

N65-36830# Santa Barbara Research Center, Goleta, Calif.
**PRODUCTION ENGINEERING MEASURE: PbSe INFRARED DETECTOR—TYPE IR-200 Quarterly Progress Report, 1 Jul. 1964–31 May 1965**
G. H. Cook 10 Aug. 1965 64 p
(Contract DA-36-039-AMC-01466(K))
(QPR-7; AD-619082)

Twelve preproduction units were fabricated, tested, and approved. There were no fabrication problems. Only insignificant test problems were encountered and these are explained. Author (TAB)

N65-36836# Materials Research Corp., Orangeburg, N. Y.
**INVESTIGATION OF ELECTRON BEAM PROCESSING OF ALUMINUM OXIDE AND RELATED MATERIALS Scientific Report No. 2**
W. Class and G. T. Murray 15 Jun. 1965 47 p refs
(Contract AF 19(628)-4089)
(AFCRL-65-464; AD-619044)

The objective of this research is the growth of superior quality crystals by a modified electron beam float-zone process. Particular emphasis has been placed upon the evaluation of this technique as a means for growing ruby. This objective requires that the growth technique be evaluated with respect to the optical perfection of the sapphire host crystal as well as the ease with which this host crystal can be doped to the required uniform chromium concentration. As reported herein, the sapphire host crystals grown by the electron beam float-zone technique were evaluated by etch pit techniques and revealed dislocation counts as low as $10^3$–$10^4$ $cm^{-2}$. The etch pit technique further disclosed the absence of substructure. These results compare favorably with flame-fusion crystals which typically exhibit both substructure and dislocation counts of $\sim 10^6$ $cm^{-2}$. Author

N65-36848# Philco Corp., Lansdale, Pa.
**PEM FOR GOLD-DOPED GERMANIUM INFRARED DETECTOR TYPE IR400 Quarterly Progress Report, 1 Jan.–31 Mar. 1965**

A. Guimento [1965] 16 p
(Contract DA-36-039-AMC-01464(E))
(QPR-9; AD-619086)

Additional preproduction samples were fabricated, environmental test procedure was modified, preproduction testing was completed and approved, and the pilot production phase was started. Author (TAB)

# 16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

**N65-35846*#** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
**DEFINITION OF OPTICAL ATMOSPHERIC EFFECTS ON LASER PROPAGATION, VOLUME III**
H. E. Henry 4 Aug. 1965 104 p refs
(Contract NASw-977)
(NASA-CR-67382; SID-65-1084 Vol. III) CFSTI: HC $4.00/MF $0.75 CSCL 20E

An extended review of types of measurements and limitations of atmospheric effects on optical propagation is given. A brief analysis of cloud transmittance indicated that for relatively thin clouds the major part of the transmitted signal is coherent, while for thick clouds the majority of the transmitted light is scattered. The applicability of analytical work on wave propagation through a random media to the prediction of the time-power spectrum of the amplitude and phase fluctuations of a propagating wave is discussed, and recommendations for additional analyses are indicated. It was concluded that ray optic methods could be used to provide a good approximation to phase problems, but not to amplitude problems. A method of acquiring and categorizing data related to the laser space communications study is also presented. G.G.

**N65-35989#** Texas Instruments, Inc., Dallas. Apparatus Research and Development Lab.
**LASER DISPLAY STUDY Final Report, 2 Jan. 1964–31 Jan. 1965**
C. E. Baker and H. W. Parker Griffiss AFB, N. Y., RADC, Jul. 1965 58 p refs
(Contract AF 30(602)-3271)
(UI-903600-1; RADC-TR-65-169; AD-619443)

The results of a program to develop a demonstration breadboard of a real-time, projection display system using a laser light source are presented. The basic features of the selected approach are reviewed, and the required system performance is translated into component parameters. Progress in techniques critical to the design of a successful breadboard, such as electro-optic light modulators, acoustic light beam scanners, gas lasers, and fiber optics, is described. The operation and evaluation of the breadboard model developed are made for continued work in view of favorable results to date. Author

**N65-36116** Joint Publications Research Service, Washington, D. C.
**SOME PROBLEMS OF SOLID STATE CONTINUOUS STIMULATED EMISSION**
Sung-hao Liu *In its* Transl. on Communist China's Sci. and Technol., No. 213 2 Sep. 1965 p 1-23 refs Transl. into ENGLISH from K'o-hsueh T'ung-pao (Peking), no.-7, 20 Jul. 1965 p 610-617 (See N65-36115 24-34) CFSTI: $2.00

Some of the problems of solid state continuous stimulated emission are discussed. Threshold power and output power of such emission, working materials for the production of stimulated emission in solids, light sources and light condensing systems, cooling and heat dissipation, and the application of solid state continuous lasers are among the specific topics considered. E.E.B.

**N65-36334#** Royal Aircraft Establishment, Farnborough (England).
**SEMI-CONDUCTOR INJECTION LASERS AND LAMPS**
G. J. Burrell May 1965 66 p refs
(RAE-TR-65095) CFSTI: HC $3.00/MF $0.75

Theoretical aspects of stimulated and spontaneous emission from semiconductors are discussed, in particular in relation to fundamental absorption coefficients. The physical mechanisms involved in radiative recombination of electrons and holes induced by injection at p–n junctions are described in relation to GaAs. Fabrication techniques for GaAs injection lasers and lamps are described in detail. Methods of operation and the measured properties of these devices are reported. Suitable semiconductors for use at room temperature as injection luminescent visible lamps are discussed, and the problems involved in producing such lamps together with means of solving these problems are indicated. Author

**N65-36393*#** College of William and Mary, Williamsburg, Va.
**MEASUREMENT OF LIGHT SCATTERED FROM A LASER BEAM BY THE ATMOSPHERE Semiannual Status Report No. 2, 1 Dec. 1964–31 May 1965**
James D. Lawrence, Jr. [1965] 10 p
(Grant NsG-710)
(NASA-CR-67498) CFSTI: HC $1.00/MF $0.50 CSCL 20E

Progress is reported on an investigation of properties of the earth's atmosphere by laser backscatter techniques. During this period, the basic receiver and laser transmitter system was completed, a number of minor modifications were made, and a series of backscatter measurements were conducted with a low power ten megawatt laser system. The laser could not be adjusted to give single pulse output and consequently the observations made cannot be considered definitive. However, the results are promising and are discussed. R.N.A.

**N65-36869#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**MASERS**
N. G. Basov, V. S. Zuyev, and K. K. Svidzinskiy 5 Apr. 1965 40 p refs Transl. into ENGLISH of chapters 1–3 from Molekulyarnyye Generatory, Tr. Fiz. Inst., Akad. Nauk SSSR (Moscow), v. 21, 1963 p 176–199
(FTD-MT-64-330; AD-615213)

The feasibility of creating a maser using inversional transitions in a beam of heavy ammonia ($ND_3$) was demonstrated using a working model of a maser on a molecular beam of $ND_3$. On the basis of theoretical calculations it is shown that in a maser on a beam of $ND_3$, conditions of self-excitation will be attained at reasonable parameters of the maser. Calculations of the hyperfine structure of the inversional spectrum of $ND_3$ were made, and derived data were used to analyze the absolute stability of the maser. The possibility of increasing absolute stability by line selection or by isotopic substitution of $N^{14}$ for $N^{15}$, is discussed. Included is a description of the installation, and results of studies using the working model. Experimental and theoretical results were in good agreement. S.C.W.

# 17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

**N65-35787*#** National Aeronautics and Space Administration, Washington, D. C.

**CONTACT INTERACTION OF METAL-LIKE CARBIDES, NITRIDES AND BORIDES WITH REFRACTORY METALS AT HIGH TEMPERATURES [KONTAKTNOYE VZAIMODEYSTYIYE METALLOPODOBNYKH KARBIDOV, NITRIDOV, I BORIDOV S TUGOPLAVKIMI METALLAMI PRI VYSOKIKH TEMPERATURAKH]**

G. V. Samsonov, L. V. Strashinskaya, and E. A. Shiller Oct. 1965 26 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Met. i Topliyo (Moscow), no. 5, 1962

(NASA-TT-F-9713) CFSTI: HC $2.00/MF $0.50 CSCL 11F

Detailed results are presented of a study of the interaction of powdered carbides (TiC, ZrC, HfC, NbC, TaC, $Mo_2C$, WC), nitrides (TiN, ZrN), and borides ($TiB_2$, $ZrB_2$, $TaB_2$) with solid Nb, Ta, Mo, and W held in contract at 900 to 2200° C for 2 or 5 hr in a vacuum. Data obtained by microscopic examination and microhardness measurements show that up to 1100° C none of the compounds tested reacts with refractory metals. Author

**N65-35799*#** Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Equipment Labs.

**DETERMINATION OF ELEVATED-TEMPERATURE FATIGUE DATA ON REFRACTORY ALLOYS IN ULTRA-HIGH VACUUM Fourth Quarterly Report, 1 Apr.–1 Jul. 1965**

C. R. Honeycutt and J. C. Sawyer 9 Jul. 1965 29 p refs (Contract NAS3-6010)

(NASA-CR-54458) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The cathetometer for measuring specimen displacement was received, and strain measurements on vibrated specimens were obtained. Tests conducted on 1/4-inch diameter smooth specimens of titanium–zirconium–molybdenum (TZM) stressed to 25 600 psi did not produce failures either at ambient temperatures of 72° F (22° C) or 1000° F (538° C) after approximately $2 \times 10^7$ cycles. The introduction of a notch having a theoretical stress concentration factor of 3, however, resulted in extremely rapid failure of TZM at an ambient temperature of 1840° F (1003° C) in tension-compression loading where the maximum stress on the unnotched cross sectional area was calculated as 16 800 psi. R.R.D.

**N65-35844*#** Advanced Metals Research Corp., Somerville, Mass.

**PROPERTIES OF NON-STOICHIOMETRIC METALLIC CARBIDES Final Report**

J. T. Norton and R. K. Lewis 6 Apr. 1964 41 p refs (Contract NASw-663)

(NASA-CR-67380) CFSTI: HC $2.00/MF $0.50 CSCL 11F

A study of the carbides of the group IV transition metals (Ti, Zr, Hf) has been made with primary emphasis on the Ti-C system. Specimens of high purity were prepared by powder metallurgy techniques over the nonstoichiometric range $TiC_{0.50}$ to $TiC_{0.95}$. Specimens of sufficiently low oxygen content and low free carbon were obtained only in the range $TiC_{0.75}$ to $TiC_{0.95}$. The following properties which could be measured on powders or non-dense specimens were determined as a function of carbon content, lattice parameter, specific gravity, thermal expansion, and thermoelectric power. The electronic structure of the nonstoichiometric carbides is discussed on the basis of the observed properties. Author

**N65-35847#** Garrett Corp., Phoenix, Ariz. AiResearch Manufacturing Div.

**MATERIALS INVESTIGATION, SNAP 50/SPUR PROGRAM. MECHANICAL PROPERTIES OF TZM Technical Report, Jan.–Oct. 1964**

R. L. Salley and E. A. Kovacevich Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 25 Jun. 1965 64 p refs (Contract AF 33(615)-2289)

(APS-5157-R; AFAPL-TR-65-51; AD-617712)

The results are presented of experimental investigations to determine what carbon content, ingot processing, and forging schedule for the TZM alloy would result in material that would satisfy the requirements of high strength and resistance to creep up to 2000° F, long-time (10 000 hours) stability without recrystallization under stress, good fabricability and (room-temperature) ductility, and compatibility with the work medium. The results indicate the development of trends; however, additional tests are recommended to extend the limits of the present data. Author

**N65-35909#** Naval Ordnance Lab., White Oak, Md.

**EFFECTS OF ALLOYING UPON CERTAIN PROPERTIES OF 55.1 NITINOL**

D. M. Goldstein, W. J. Buehler, and R. C. Wiley Aug. 1965 31 p refs

(NOLTR-64-235; AD-618681)

Ternary alloys of the intermetallic compound TiNi were hot hardness tested. Although hardness can be increased by such alloying, neither the base material nor the alloys offer promise for long time service use above 800° F. Silicon, aluminum, iron, and cobalt are effective room temperature hardeners. A unique interfacial compatibility between TiNi and tungsten bulk metal was discovered. It is believed that this will enable introduction of a new metal-metal composite system of fibrous tungsten in a Nitinol matrix. A rod of such material is shown to be capable of room temperature swaging, suggesting improved methods of working highly refractory metals. Silver-free TiNi brazing alloys for joining tungsten metals are a natural result of such compatibility. Author

**N65-35927#** Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.

**RESEARCH STUDIES ON THERMIONIC CONVERTERS, EMITTER SHELL PHASE Final Report, 1 Jul. 1963–28 Feb. 1965**

G. Y. Eastman Mar. 1965 140 p refs (Contract DA-36-039-AMC-03197(E))

(Rept.-5; AD-618923)

The objective of the program was the development of a barrier shell to protect thermionic energy converters from the combustion products of a fossil fuel flame. Two material properties are of prime importance: impermeability, and corrosion resistance. A literature survey was performed to select promising materials from the standpoint of properties, availability, and fabrication potential. Three types of materials were selected for extensive testing; alumina, beryllia and silicon carbide. Equipment of very high sensitivity ($10^{-12}$ liter torr/$cm^2$ second) was developed which permitted the

determination of gas permeation rates. The identification of individual gases was made possible by the latest mass spectrometer equipment. It was determined that high purity alumina has the lowest permeation rate, the highest material strength, good thermal shock resistance and is resistant to corrosion. Beryllium oxide had a poor corrosion resistance and a high permeation rate for carbon monoxide. The pyrolytic silicon carbide samples obtained for this program evidenced high permeation rates for carbon monoxide and showed a tendency toward unpredictable fracture after extended periods at elevated temperatures. Author

**N65-35957*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
**ELEVATED-TEMPERATURE TENSILE PROPERTIES OF ALLOYED TUNGSTEN FIBER COMPOSITES**
Donald W. Petrasek Washington, NASA, Oct. 1965 31 p refs
(NASA-TN-D-3073) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The effects of selected alloying elements on the elevated temperature tensile properties of tungsten fiber reinforced composites were studied. Composites were made of copper, copper-2 percent chromium and copper-10 percent nickel reinforced with various volume percents of uniaxially oriented tungsten fibers. The composites were tested in tension at temperatures up to 1800° F. A comparison of the elevated-temperature tensile properties of tungsten fiber–copper alloy composites, representing soluble systems, was made with tungsten fiber–copper composites, representing a mutually insoluble system. The effects of alloying on the elevated-temperature tensile properties of tungsten fiber reinforced composites was also studied. A linear relation existed at elevated temperatures between tensile strength and volume percent fiber content for all the systems investigated. The copper alloy composites were weaker in tension at high volume percent fiber contents than copper composites in which alloying with the fiber did not occur. The tensile strength of the alloyed tungsten fiber decreased with increasing penetration of the alloying element into the tungsten fiber. Author

**N65-35970*#** Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.
**MAGNETIC MATERIALS TOPICAL REPORT: RESEARCH AND DEVELOPMENT PROGRAM ON MAGNETIC, ELECTRICAL CONDUCTOR, ELECTRICAL INSULATION, AND BORE SEAL MATERIALS**
P. E. Kueser et al Sep. 1964 611 p refs
(Contract NAS3-4162)
(NASA-CR-54091, WAED-64-52E) CFSTI: HC $9.00/MF $3.00 CSCL 13H

Magnetic, mechanical, and thermophysical property data on magnetic materials suitable for application in advanced space electric power systems; are reported. Focused on are: magnetic electrical conductor materials, electrical insulation materials, and bore seal materials. An extensive literature search was made and results, as well as significant references, are listed in punched-card format. A technical discussion which describes the applications of electrical materials to advanced space electric power systems is presented. Also discussed are the selected materials and the observations made during the test program. Material specifications, specimen configurations, and test procedures, are defined. Tabular and graphic property data are organized for use as a design manual. A master index for all properties is included, and each material has a summary which can be used as a guide in selection. S.C.W.

**N65-36025#** Nuclear Metals, Inc., Concord, Mass.
**TECHNICAL PAPERS OF THE FOURTEENTH METALLOGRAPHIC GROUP MEETING**
H. P. Roth, comp. 6 Jan. 1964 176 p refs Meeting held 5–6 Apr. 1960
(NMI-4996) CFSTI: $5.00

CONTENTS:

1. AN IMPROVED METHOD OF ETCHING BY ION BOMBARDMENT T. K. Bierlein and B. Mastel (GE) p 1–7 refs (See N65-36026 24-15)

2. METALLOGRAPHIC OBSERVATIONS AT ELEVATED TEMPERATURE J. R. Dvorak and R. F. Domagala (IIT Res. Inst.) p 8–18 refs (See N65-36027 24-17)

3. NOVEL METALLOGRAPHIC UTILIZATION OF REPLICAS AND MICRAUTORADIOGRAPHY T. K. Bierlein and B. Mastel (GE) p 19–26 (See N65-36028 24-17)

4. DECREASING THE ELECTROPOLISHING TIME FOR URANIUM L. Robins and M. F. Garufi (Bridgeport Brass Co.) p 27–35c (See N65-36029 24-15)

5. METALLOGRAPHY OF BERYLLIUM OXIDE C. G. Rhodes (GE) p 36–49 (See N65-36030 24-17)

6. ELECTRON MICROSCOPE STUDIES OF BERYLLIUM OXIDE POWDERS M. G. Bolinger, Jr. (GE) p 50–76 refs (See N65-36031 24-17)

7. METALLOGRAPHIC PREPARATION OF IRRADIATED URANIUM CARBIDE A. A. Bauer and F. E. Mc Grath (Battelle Mem. Inst.) p 77–85 ref (See N65-36032 24-15)

8. SWELLING IN URANIUM AS A FUNCTION OF POST-IRRADIATION ANNEALING T. K. Bierlein and B. Mastel (GE) p 86–113 refs (See N65-36033 24-17)

9. METALLOGRAPHIC CHARACTERISTICS OF OXIDES, NITRIDES, AND CARBIDES IN ALPHA TANTALUM R. W. Anderson (Los Alamos Sci. Lab.) p 114–122 refs (See N65-36034 24-17)

10. OBSERVATIONS ON THE MICROSTRUCTURE OF PLUTONIUM R. D. Nelson and H. R. Gardner (GE) p 123–136 ref (See N65-36035 24-17)

11. SOME PRELIMINARY METALLOGRAPHIC STUDIES OF MATERIALS FOR USE ABOVE 2500° C C. G. Hoffman (Los Alamos Sci. Lab.) p 137–148 (See N65-36036 24-15)

12. X-RAY FILM DEFECTS AND AUTORADIOGRAPHY OF FUEL ELEMENTS FOR CLADDING THICKNESS MEASUREMENT H. P. Roth p 149–163 (See N65-36037 24-22)

13. SOME METALLOGRAPHIC OBSERVATIONS ON THORIUM METAL D. T. Peterson (Iowa State Univ. of Sci. and Technol.) p 164–168 ref (See N65-36038 24-17)

**N65-36027** IIT Research Inst., Chicago, Ill.
**METALLOGRAPHIC OBSERVATIONS AT ELEVATED TEMPERATURE**
J. R. Dvorak and R. F. Domagala *In* Nuclear Metals, Inc. Tech Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 8–18 refs (See N65-36025 24-17) CFSTI: $5.00

Room-temperature metallography is limited to viewing structures which are either stable at room temperature or which can be retained in a metastable state by quenching from a higher temperature. Elevated-temperature metallography permits observations of structural phenomena as they occur. Three factors appear to govern the ability to observe structural changes at elevated temperatures: the effect of thermal etching, the relative emissivity or reflectivity of the phases, and surface contour changes which take place during heating or cooling as a result of volume changes during precipitation or transformation. In this work attempts were made to view the allotropic transformation in pure iron, recrystallization and grain growth in pure copper, and isothermal transformation processes in several alloys. Author

**N65-36028** Hanford Atomic Products Operation, Richland, Wash.
**NOVEL METALLOGRAPHIC UTILIZATION OF REPLICAS AND MICROAUTORADIOGRAPHY**
T. K. Bierlein and B. Mastel *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 19–26 (See N65-36025 24-17) CFSTI: $5.00

A method for conducting microautoradiography and metallography on radio and chemically active materials is described and illustrated. In the case of intermetallic compound formation between uranium and AlSi, an etched specimen is coated with Saran which, in turn, is coated with NTB liquid emulsion. After suitable exposure and processing, the Saran and adherent emulsion is stripped with Scotch tape from the specimen. Bright field, reflected light examination of this stripped replica reveals the microstructural detail; polarized light examination of the stripped replica, the reduced silver gains in the emulsion. Correlation of the tracks in the emulsion and microstructural features on the replica is simple and unambiguous. Author

**N65-36030** General Electric Co., New York. Aircraft Nuclear Propulsion Dept.
**METALLOGRAPHY OF BERYLLIUM OXIDE**
Cecil G. Rhodes *In* Nuclear Metals, Inc., Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 36–49 (See N65-36025 24-17) CFSTI: $5.00
(GE-ANPD-DC-59-2-133)

This is a preliminary report on the metallographic examination of beryllia samples. The metallographic procedures used for preparing metallic samples can be used for BeO samples. Porosity is a major problem in microstructure interpretation. Mechanical porosity can, however, be distinguished from natural porosity. Impurities are mainly metallic. The ultimate grain size of hot-pressed samples and sintered samples could not be correlated to fabrication times, temperatures, or pressures. Beryllia samples nearly always have equiaxed grains; however, several samples had rod-shaped grains. In an isothermal (1500° C) test conducted in 25 hour increments, the grain sized tripled in 100 hours. Author

**N65-36031** General Electric Co., New York. Aircraft Nuclear Propulsion Dept.
**ELECTRON MICROSCOPE STUDIES OF BERYLLIUM OXIDE POWDERS**
M. G. Bolinger, Jr. *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 50–76 refs (See N65-36025 24-17) CFSTI: $5.00

This report describes the electron microscope investigations of beryllium oxide powders and relates their contribution to the advancement of beryllium oxide technology pertinent to the aircraft nuclear propulsion. Results are presented to characterize the physical and morphological features of various beryllium oxide powders in relation to parent compounds, calcination conditions, fabricated density and chemical purity. Electron microscope particle size data have been tabulated and the results are compared with X-ray diffraction, line-broadening and surface area measurements to facilitate a complete particle size perspective. Author

**N65-36033** Hanford Atomic Products Operation, Richland, Wash.
**SWELLING IN URANIUM AS A FUNCTION OF POST-IRRADIATION ANNEALING**
T. K. Bierlein and B. Mastel *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 86–113 refs (See N65-36025 24-17) CFSTI: $5.00

Specimens from two cylindrical rods of restrained uranium irradiated to burnups of 0.29 and 0.41 a/o at temperatures of 500° C in the core and 350° C on the periphery have been annealed for 100 hours at 600, 650, 700, and 880° C. The resultant swelling in the unrestrained specimens has been studied by optical and electron metallographic techniques. Problems associated with the statistical determination of fission gas pore diameters and their distribution are discussed. The results obtained permit qualitative observations on fission gas mobility and the nucleation and growth of fission gas pores. The effect of temperature and burnup on swelling in uranium is illustrated by representative micrographs. Author

**N65-36034** Los Alamos Scientific Lab., N. Mex.
**METALLOGRAPHIC CHARACTERISTICS OF OXIDES, NITRIDES, AND CARBIDES IN ALPHA TANTALUM**
Robert W. Anderson *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 114–122 refs (See N65-36025 24-17) CFSTI: $5.00

Tantalum, with controlled additions of oxygen, nitrogen, and carbon, was studied metallographically. It is shown that the characteristics of the resulting compounds in alpha tantalum are dependent on the temperature at which they are formed. Author

**N65-36035** Hanford Atomic Products Operation, Richland, Wash.
**OBSERVATIONS ON THE MICROSTRUCTURE OF PLUTONIUM**
R. D. Nelson and H. R. Gardner *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 123–136 ref (See N65-36025 24-17) CFSTI: $5.00

The procedure and technique of metallographic examination of plutonium and plutonium alloys are discussed. Metallographic studies were made on plutonium buttons reduced from plutonium fluoride; on plutonium ingots recast from buttons; on several plutonium alloys; on the effect of tension and compression in the alpha, beta, gamma and delta phases on the microstructure of recast ingots; on the formation of voids in thermally-cycled plutonium and a plutonium uranium alloy; and on the effect of different casting and heat-treating conditions. Author

**N65-36038** Iowa State Univ. of Science and Technology, Ames.
**SOME METALLOGRAPHIC OBSERVATIONS ON THORIUM METAL**
David T. Peterson *In* Nuclear Metals, Inc. Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 164–168 ref (See N65-36025 24-17) CFSTI: $5.00
(Contract W-7405-ENG-82)
(IS-155)

The occurrence of extensive twinning is a prominent feature of the microstructures of arc-melted thorium. The twin boundaries and subgrain boundaries may influence the mechanical properties of thorium. A new electropolishing technique promises to simplify the examination of minor phases in thorium and may reveal details of the mechanism of deformation. Author

**N65-36075#** Nuclear Metals, Inc., Concord, Mass.
**TECHNICAL PAPERS OF THE FIFTEENTH METALLOGRAPHIC GROUP MEETING**
H. Roth Roman, comp. Washington, AEC, 1 May 1964 243 p refs Meeting held May 17–19, 1961 at Savannah River Lab., Aiken, S. Carolina
(NMI-4997; CONF-610501) CFSTI: $6.00

CONTENTS:

1. METALLOGRAPHY—ALLY OF NONDESTRUCTIVE TESTING IN EVALUATING NUCLEAR FUEL COMPONENTS C. H. Bean and W. J. McGonnagle (Argonne Natl. Lab.) p 1–21 refs (See N65-36076 24-15)

2. METALLOGRAPHIC PREPARATION OF HARD AND BRITTLE MATERIALS J. R. Dvorak (IIT Res. Inst.) p 22–25 (See N65-36077 24-17)

3. MEASUREMENT OF THE THICKNESS OF ALUMINUM OXIDE FILM L. P. Costas and E. C. Hoxie (Du Pont de Nemours (E. I.) and Co., Aiken, S. C.) p 26–35 (See N65-36078 24-15)

4. PRELIMINARY EVALUATION OF A NEW POLISHING CLOTH R. S. Crouse (Oak Ridge Natl. Lab.) p 36–44 ref (See N65-36079 24-15)

5. METALLOGRAPHIC STUDIES OF URANIUM-FISSIUM ALLOYS S. T. Zegler, M. V. Nevitt, R. P. Wilhelm, and R. A. Conner, Jr. (Argonne Natl. Lab.) p 45–54 refs (See N65-36080 24-17)

6. MICROSTRUCTURES OF COMPOUNDS OF URANIUM, THORIUM, AND BERYLLIUM C. R. Thompson, M. S. Farkas, and A. A. Bauer (Battelle Mem. Inst., Columbus) p 55–61 (See N65-36081 24-17)

7. A MICROGRAPHIC STUDY OF THE EFFECT OF MOISTURE IN THE AIR ON ARC-CAST URANIUM MONOCARBIDE AND URANIUM DICARBIDE AT ROOM TEMPERATURE OVER EXTENDED PERIODS R. J. Gray and C. K. H. DuBose (Oak Ridge Natl. Lab.) p 62–75 refs (See N65-36082 24-17)

8. HIGH-TEMPERATURE METALLOGRAPHY OF URANIUM C. L. Angerman (Du Pont de Nemours (E. I.) and Co., Aiken, S. C.) p 76–84 refs (See N65-36083 24-17)

9. METALLOGRAPHIC PREPARATION OF ALUMINA COATED $UO_2$ SPHERES IN GRAPHITE J. M. Lott, M. S. Farkas, and A. A. Bauer (Battelle Mem. Inst., Columbus) p 85–91 (See N65-36084 24-17)

10. HYDRIDE APPEARANCE AND DISTRIBUTION IN ZIRCONIUM BASE ALLOYS A. E. Bibb (GE, Schenectady) p 92–109 ref (See N65-36085 24-17)

11. METALLOGRAPHY OF FUSED $UO_2$ G. R. Cole (Du Pont de Nemours (E. I.) and Co., Aiken, S. C.) p 110–123 refs (See N65-36086 24-06)

12. METALLOGRAPHY OF IRRADIATED DISPERSION-TYPE FUEL ELEMENTS A. E. Richt, E. J. Manthos, and E. D. Sims (Oak Ridge Natl. Lab.) p 124–133 ref (See N65-36087 24-17)

13. HOT CELL METALLOGRAPHIC EXPERIENCE AT BATTELLE F. E. McGrath and A. A. Bauer (Battelle Mem. Inst., Columbus) p 134–156 (See N65-36088 24-15)

14. A REMOTE METALLOGRAPHIC SPECIMEN GRINDER E. L. Long, Jr., A. E. Richt, D. L. Holcomb, and R. J. Gray (Oak Ridge Natl. Lab.) p 157–162 (See N65-36089 24-15)

15. METALLOGRAPHY OF U—2 WT % Zr ALLOY BEFORE AND AFTER IRRADIATION C. L. Angerman and W. R. McDonell (Du Pont de Nemours (E. I.) and Co., Aiken, S. C.) p 163–183 refs (See N65-36090 24-17)

16. EXPERIENCE WITH VIBRATORY POLISHERS AND DESIGN FOR HOT-CELL APPLICATION E. L. Long, Jr., R. J. Gray, and J. T. Meador (Oak Ridge Natl. Lab.) p 184–188 refs (See N65-36091 24-15)

17. REMOTE METALLOGRAPHIC PREPARATION OF IRRADIATED ALUMINUM-CLAD LEAD-BONDED CERAMIC FUEL PELLETS R. Carlander (Argonne Natl. Lab.) p 189–197 (See N65-36092 24-15)

18. METALLOGRAPHY OF PYROLYTIC CARBON COATED AND UNCOATED URANIUM CARBIDE SPHERES C. K. H. DuBose and R. J. Gray (Oak Ridge Natl. Lab.) p 198–237 refs (See N65-36093 24-15)

**N65-36077** IIT Research Inst., Chicago, Ill.
**METALLOGRAPHIC PREPARATION OF HARD AND BRITTLE MATERIALS**
J. R. Dvorak *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 22–25 (See N65-36075 24-17) CFSTI: $6.00

A new and somewhat unconventional method has been developed for the metallographic preparation of boron-carbon alloys. These hard and brittle materials are polished in three steps utilizing an automatic mechanical polisher. Two of these operations are performed without the use of conventional cloth-covered wheels. The abrasive is applied directly to a wheel which is fabricated from selected materials. Although the polishing procedure is somewhat time consuming, it would be almost impossible to polish these samples by conventional techniques. The results are excellent; very little relief is produced even in samples of the boron carbide-graphite eutectic. No chipping or pullouts are produced in the extremely brittle phases. This same polishing technique can be successfully applied to other brittle materials. Author

**N65-36080** Argonne National Lab., Ill.
**METALLOGRAPHIC STUDIES OF URANIUM-FISSIUM ALLOYS**
S. T. Zegler, M. V. Nevitt, R. P. Wilhelm, and R. A. Conner, Jr. *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 45–54 refs (See N65-36075 24-17) CFSTI: $6.00

The results of a metallographic study on the influence of small additions of Si, Ti, Al, and Y in improving the ductility of castings of the uranium-fissium alloy U–5 w/o Fs–2.25 w/o Zr are presented (Fs = fissium and refers to the complement of fission product elements that remain in a spent reactor fuel following pyrometallurgical refining in fuel recycling programs). The case structure of the alloy, alloy preparation, and metallographic preparation and observations are described. R.N.A.

**N65-36081** Battelle Memorial Inst., Columbus, Ohio.
**MICROSTRUCTURES OF COMPOUNDS OF URANIUM, THORIUM, AND BERYLLIUM**
C. R. Thompson, M. S. Farkas, and A. A. Bauer *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 55–61 (See N65-36075 24-17) CFSTI: $6.00

Metallographic techniques for the satisfactory preparation of some uranium, thorium-uranium, and beryllium compounds were developed. The cutting, mounting, grinding, and polishing procedures are discussed, and photographs of microstructures of the prepared compounds are presented. L.S.

**N65-36082** Oak Ridge National Lab., Tenn.
**A MICROGRAPHIC STUDY OF THE EFFECT OF MOISTURE IN THE AIR ON ARC-CAST URANIUM MONOCARBIDE AND URANIUM DICARBIDE AT ROOM TEMPERATURE OVER EXTENDED PERIODS**

R. J. Gray and C. K. H. Du Bose *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 62–75 refs (See N65-36075 24-17) CFSTI: $6.00

Specimens consisting primarily of uranium monocarbide showed an increase in the severity of fissures after periodic removal from a storage desiccator for examination in ambient laboratory atmosphere. In uranium monocarbide and uranium dicarbide specimens, the amount of fissuring varied inversely with the uranium dicarbide content in the range of 10 to 90 percent. Uranium monocarbide specimens with minor amounts of $\alpha$-uranium were observed to develop fissures and minute eruptions in a short time if fully exposed to the ambient atmosphere, but could be sealed in a desiccator and remain inactive for a seemingly indefinite time. Author

**N65-36083** Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

**HIGH-TEMPERATURE METALLOGRAPHY OF URANIUM**

C. L. Angerman *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 76–84 refs (See N65-36075 24-17) CFSTI: $6.00
(Contract AT(07-2)-1)

The changes in the microstructure of uranium that occurred during heating and cooling through the allotropic transformations were recorded by time-lapse photography on 16 mm movie films. Electropolished uranium specimens were heated in a hot stage by an external nichrome heater. The stage, mounted on a metallograph, was evacuated to at least $3 \times 10^{-6}$ mm Hg. During heating, the original grain structure became visible due to relief that resulted from differences in thermal expansion between adjacent grains. At the appropriate temperatures the transformations moved as fronts that emanated from several points in the structure. The $\alpha$-$\beta$ transformation occurred at a faster rate than the $\beta$-$\gamma$ transformation. Grain boundaries of the $\beta$ and $\gamma$ phases were visible after the respective transformations. Author

**N65-36084** Battelle Memorial Inst., Columbus, Ohio.

**METALLOGRAPHIC PREPARATION OF ALUMINA COATED $UO_2$ SPHERES IN GRAPHITE**

J. M. Lott, M. S. Farkas, and A. A. Bauer *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 85–91 (See N65-36075 24-17) CFSTI: $6.00

A satisfactory method of preparing graphite containing alumina-coated $UO_2$ particles for metallographic examination was devised, and cold metallographic procedures were modified so that hot cell preparation could be performed using vibratory polishers. Problems arising in the preparations are discussed, and examples of prepared specimens are pictured. L.S.

**N65-36085** General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.

**HYDRIDE APPEARANCE AND DISTRIBUTION IN ZIRCONIUM BASE ALLOYS**

A. E. Bibb *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 92–109 ref (See N65-36075 24-17) CFSTI: $6.00

This report summarizes observations made on the appearance and distribution of hydrides in zirconium-base alloys. It is shown that the hydrides may be precipitated on habit planes within grains or at grain boundaries, regardless of whether the hydrogen is introduced by means of a Sieverts type apparatus or picked up during corrosion in an aqueous medium. Irradiation in a neutron flux does not alter the tendency of the hydrides to precipitate on habit planes or at grain boundaries. Author

**N65-36087** Oak Ridge National Lab., Tenn.

**METALLOGRAPHY OF IRRADIATED DISPERSION-TYPE FUEL ELEMENTS**

A. E. Richt, E. J. Manthos, and E. D. Sims *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 124–133 ref (See N65-36075 24-17) CFSTI: $6.00

Metallographic examinations were made of a stainless steel–$UO_2$ dispersion element obtained from a SM-1 reactor fuel element, and aluminum clad dispersion type elements, consisting of a U–Si–Al alloy, a $UC_2$ dispersion, and a $U_3O_8$ dispersion type, obtained from miniature irradiation samples. All specimens were aluminum clad by the picture-frame method and were irradiated in the MTR (materials testing reactor) at calculated centerline temperatures of approximately 80° C. Burnups from 15 to 60% $U^{235}$ were achieved. Metallographic examination of sections of an SM-1 fuel element exposed to 2/3 core life revealed no serious damage to the fueled portion of the fuel plate. Minor structural changes were noted in $UO_2$ particles. Metallographic examination of the U–Si–Al and $U_3O_8$ dispersion type fuel element specimens indicate that both are capable of withstanding high burnups without serious damage. Specimens of the $UC_2$ dispersion type exhibited serious swelling after irradiation which appears to be related to fabricational problems and only indirectly to irradiation effects. R.N.A.

**N65-36090** Dupont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.

**METALLOGRAPHY OF U–2 WT% Zr ALLOY BEFORE AND AFTER IRRADIATION**

C. L. Angerman and W. R. Mc Donell *In* Nucl. Metals Tech. Papers of the 15th Metallographic Group Meeting 1 May 1964 p 163–183 refs (See N65-36075 24-17)
(Contract AT(07-2)-1) CFSTI: $6.00

As part of a general study of the factors that will produce the maximum volume stability of metallic fuel elements for power reactors, optical and electron metallography and electron diffraction were used to characterize the response of unirradiated U–2 wt. % Zr alloy to heat treatment and the effects of irradiation on the alloy. A new technique was developed for isolating the second-phase particles for identification by electron diffraction. Both the matrix grain size and the second-phase distribution were dependent upon heat treatment before irradiation. Two important observations were the retention of the $\gamma_1$ phase upon quenching from temperatures in the $\beta + \gamma_1$ region, and the formation of the $\delta$ phase instead of $\gamma_2$ upon annealing at 650° C, which is in the $\alpha + \gamma_2$ region. Irradiation of a two-phase structure of $\alpha + \delta$ formed large concentrations of gas bubbles near the second-phase particles. As the burnup increased, the second-phase particles became distorted and some of the particles dissolved. Author

**N65-36094#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CONFERENCE ON METALLOGRAPHY AND HEAT TREATMENT, MATERIALS Selected Articles**

9 Apr. 1965 24 p refs Transl. into ENGLISH of 2 articles from "Konferentsiya po Metallovedeniyu i Termicheskoy Obrabotke, Materialy," Odessa, 1960 p 211–215, 245–257
(FTD-TT-64-799/1+2; AD-614944)

CONTENTS:

1. NITRIDING OF STEEL UNDER THE EFFECT OF ULTRASOUND G. V. Zemskov, L. K. Gushchin, Ye. V. Dombrovskaya et al p 1–6 refs (See N65-36095 24-17)

2. CHARACTERISTIC FEATURES OF STEEL NITRIDED AT HIGH TEMPERATURES T. M. Pogrebetskaya, A. A. Yurgenson, and A. V. Kostenko p 7–21 (See N65-36096 24-17)

**N65-36095** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**NITRIDING OF STEEL UNDER THE EFFECT OF ULTRASOUND**
G. V. Zemskov, L. K. Gushchin, and Ye. V. Dombrovskaya et al *In its* Conf. on Metallog. and Heat Treatment, Mater. 9 Apr. 1965 p 1-6 refs (See N65-36094 24-17)

An investigation of the effect of ultrasound on the nitriding of steel in both gaseous and liquid media is presented. Nitriding was done at 500° C and 550° C, and exposures of 2, 4, 6, 8, 10, and 15 hours, with and without the effect of ultrasound. It is shown that the application of ultrasound exerts a positive effect, increasing the hardness and depth of nitrogen penetration. In addition, it assures a more uniform distribution of microhardness over the thickness of the nitrided layer, particularly, as a result of an exposure exceeding six hours. An increase in exposure to 15 hours reduces microhardness directly in the surface layer, but the microhardness in the central zone of the nitrided layer continues rising. C.T.C.

**N65-36096** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CHARACTERISTIC FEATURES OF STEEL NITRIDED AT HIGH TEMPERATURES**
T. M. Pogrebetskaya, A. A. Yurgenson, and A. V. Kostenko *In its* Conf. on Metallog. and Heat Treatment, Mater. 9 Apr. 1965 p 7-21 (See N65-36094 24-17)

An investigation to determine the changes in the structure of a nitrided layer which takes place during long lasting high temperature exposures is presented. Experiments were conducted on nitrided samples of machine components at their characteristic operating temperatures of 535° C to 680° C, and exposure times to 6000 hours. The surface hardness, thickness of the nitrided layer, and the distribution of microhardness over the thickness of the layer were determined after the exposure. It is shown that the surface hardness of all the investigated steels decreases, while the thickness on the nitrided layer increases. Graphs are given which show the microhardness distribution. It is concluded that the temperature boundaries for applying nitrided steel are determined by the temperature of dissociation of nitrides. To preserve hardness and thickness of nitrided layers, it is necessary to use steel containing greater amounts of elements forming stable and finely dispersed nitrides. C.T.C.

**N65-36167#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**MARTENSITE CONVERSION IN ALLOYS WITH AGING MARTENSITE**
A. P. Gulyayev and N. I. Karchevskaya 13 Aug. 1965 8 p refs Transl. into ENGLISH from Metalloved. i. Term. Obrabotka Metal. (Moscow), no. 11, 1964 p 2-5
(FTD-TT-65-670/1+2+4; AD-620773)

Molybdenum reduces, and cobalt increases the martensite interval in alloys Fe plus 20% Ni. The investigated alloying elements affect the martensite interval in the system Fe-20% Ni in the same way as in steel. Since before the aging, the alloys should have a martensite structure (aging effect is due to processes taking place in $\alpha$-phase), then the content of molybdenum, sharply decreasing the martensite point, should be limited to 3% (if no treatment is used). In the presence of cobalt-element increasing martensite points, the content of molybdenum can be increased to 5%. The positive role of cobalt in alloys of this type apparently lies in the fact that the addition of cobalt allows one to increase the content of molybdenum in the alloys. Hardness of annealed (not aged) alloy does not depend upon the ratio of austenite and martensite. Evidently, hardness of carbonless unaged martensite practically coincides with the hardness of the initial austenite. In the investigated alloys hardness cannot serve as a criterion of the degree of hardening. Author

**N65-36180#** Franklin Inst., Philadelphia, Pa. Research Labs.
**FLOW AND FRACTURE STUDIES OF HIGH PURITY AND ALLOYED BERYLLIUM Quarterly Progress Report, Oct. 7, 1964-Jan. 6, 1965**
M. Herman, G. London, V. Damiano, and G. S. Tint [1965] 14 p refs
(Contract NOw-64-0437-d)
(Q-B2205-3; AD-620589)

In this quarter the progress in zone melting and the preparing of a Be-Cu alloy is presented. In addition a theoretical analysis is presented on the stress required to initiate plastic flow on selected slip planes in beryllium. Author

**N65-36221#** California Univ., Livermore. Lawrence Radiation Lab.
**VAPORIZATION OF ADVANCED POWERPLANT METALS UNDER VACUUM AND FORCED CONVECTION CONDITIONS**
G. E. Zima 24 Jun. 1965 26 p refs
(Contract W-7405-ENG-48)
(UCRL-14274) CFSTI: $2.00

Structural metals for advanced powerplants will have to operate at temperatures so high that attrition of the metal by vaporization may become a problem. This report describes calculations made for several potential structural metals to determine mass loss, surface recession, and change in cross-sectional area resulting from protracted vaporization (10,000 hr) under vacuum and under forced convection. An arbitrary forced convection situation was assumed: helium under 1 atm total pressure and with free-stream velocity of 100 ft/sec. Results indicate that vaporization will not be a problem for tungsten, rhenium, and tantalum below temperatures of about 4000° F. For molybdenum, vaporization may become troublesome at about 2900° F in vacuum and 3300° F under forced convection. To allow for forced convection conditions different from those assumed in the above-mentioned calculations, corrections are given for total pressure, temperature, free-stream velocity, and distance from the leading edge of the metal shape along which the gas is flowing. Also given are factors for converting from convection with helium to convection with argon or hydrogen. Author

**N65-36225#** Franklin Inst., Philadelphia, Pa. Research Labs.
**FLOW AND FRACTURE STUDIES OF HIGH PURITY AND ALLOYED BERYLLIUM Final Report**
M. Herman, D. Hoover, V. Damiano, R. Pyle, G. S. Tint et al Aug. 1965 59 p refs
(Contract NOw-64-0437-d)
(F-B2205; AD-620188)

An investigation is presented on the deformation and fracture characteristics of high purity and alloyed beryllium in single crystal and polycrystalline form. Included are single crystal deformation studies of pure and alloyed crystals, zone refining work dealing with the purification and alloying of beryllium and the perfecting of an automated system for zone melting, the preparation of pure and alloyed polycrystalline beryllium, a theoretical calculation of the stress required to initiate slip on selected crystallographic planes in beryllium, and a description of a single crystal orienter which was constructed to facilitate the preparation of accurately orientated compression specimens. R.N.A.

N65-36228# Frankford Arsenal, Philadelphia, Pa. Pitman-Dunn Research Labs.
**THE STRESS CORROSION AND ELEVATED TEMPERATURE PROPERTIES OF MAGNESIUM-LITHIUM-SILICON ALLOYS**
Anthony Saia and Ralph E. Edelman Oct. 1964 15 p refs Presented at the 21st Ann. Meeting, Magnesium Assoc., New York, 5–7 Oct. 1964
(FA-A64-31; AD-620329)

Silicon additions improved the stress corrosion resistance of magnesium-lithium alloys in the as-quenched condition. In the stabilized condition, none of the alloys, with or without silicon exhibited any stress corrosion. The silicon-bearing alloys investigated exhibited improved elevated temperature properties over the alloys without silicon. Author

N65-36230# Franklin Inst., Philadelphia, Pa. Research Labs.
**FLOW AND FRACTURE STUDIES OF HIGH PURITY AND ALLOYED BERYLLIUM Quarterly Progress Report, Apr. 6–Jul. 5, 1964**
M. Herman, D. Hoover, V. Damiano, and R. Pyle [1964] 35 p refs
(Contract NOw-64-0437-d)
(Q-B2205-1; AD-620238)

The purpose of this investigation is to produce high purity beryllium and beryllium alloys. This material is then to be studied to determine its deformation and fracture properties in the single crystal and polycrystalline states. Author

N65-36244# Franklin Inst., Philadelphia, Pa. Research Labs.
**PREPARATION AND EVALUATION OF HIGH PURITY BERYLLIUM Final Report, Oct. 15, 1963–Jan. 14, 1964**
G. E. Spangler, M. Herman, D. B. Hoover, and V. V. Damiano [1964] 97 p refs
(Contract NOw-63-0500-d)
(F-B2089; AD-620264)

Zone refining of beryllium by an automatic vertical-floating zone melting process continued—several beryllium bars were completed, and some bars were alloyed with copper. Room temperature tensile tests on BeCu crystals established their basal plane sensitivity to alloying. Beryllium single crystals from zone melted material were shaped by electro-spark discharge and electrolytic machining and tensile tested to establish their load extension curves. The specimens deformed by basal glide. The ductility effect of extensive alloying of copper was mitigated by an apparent decrease in the susceptibility of the lattice to cleave on the basal plane. A method to measure the self diffusion in beryllium single crystals by means of radioactive tracer flow is described, and diffusivity values perpendicular to basal plane are presented for temperatures from 553° C through 1025° C. G.G.

N65-36258# Franklin Inst., Philadelphia, Pa. Research Labs.
**FLOW AND FRACTURE STUDIES OF HIGH PURITY AND ALLOYED BERYLLIUM Technical Report, 7 Jul.–6 Oct. 1964**
M. Herman, D. Hoover, V. Damiano, and R. Pyle [1964] 15 p ref
(Contract NOw-64-0437-d)
(Q-B2205-2; AD-620241)

The purpose of this investigation is to study the deformation and fracture characteristics of high purity and alloyed beryllium in single crystal and polycrystalline form. In this quarter the progress in zone melting beryllium, the automating of a 1" diameter zone melter, and the preparing of a polycrystalline beryllium-copper alloy is presented. In addition, a series of experiments designed to detect slip out of the basal plane is presented and interpreted. Author

N65-36294# Massachusetts Inst. of Tech., Cambridge. Metals Processing Lab.
**DEFORMATION PROCESSING OF ANISOTROPIC METALS Final Report**
W. A. Backofen, D. H. Avery, and D. Lee 15 Jul. 1965 138 p refs
(Contract NOw-65-0124-d)
(AD-620687)

Titanium of commercial purity (RC-70) and two all-alpha (HCP) alloys (4AL-I/402 and 5AL-2.SSN) were tested in sheet form under conditions of combined stress loading. Plane-strain compression and plane-strain tension together with uniaxial compression and tension provided information for constructing the tension–tension and compression–compression quadrants of the plane-stress yield locus. The deformation of textured sheet of titanium and several of its all-alpha (HCP) alloys was investigated with basically two kinds of experiments: tension testing along different directions in the plane of the sheet and combined stress loading along principal axes of anisotropy (the rolling and transverse directions). Texture and plastic anisotropy were evaluated with pole figures and by measurement, as a function of orientation, of the tensile transverse strain ratio, or R parameter. A phenomenological explanation of superplasticity in metals has been based on the observation of a strong strain-rate dependence of flow stress, comparable to that of heated polymers and approaching that of hot glass. A structural basis for such high rate sensitivity is suggested in the present paper. It is argued that at temperatures about $0.5T_M$ two competitive processes contribute to deformation. TAB

N65-36297# Watervliet Arsenal, N. Y. Benet R&E Labs.
**HYDROSTATIC PRESSURE INDUCED PLASTIC FLOW IN POLYCRYSTALLINE METALS**
T. E. Davidson, J. C. Uy, and A. P. Lee Dec. 1964 16 p refs (WVT-6431; AD-612881)

The effects of hydrostatic pressures to 26 kbars on the microstructure of polycrystalline Cd, Zn, Bi, Sn, Zr, Mg, Cu, and Fe were examined. Pressure induced microscopic plastic flow in the form of boundary migration, slip, multiple slip or twining have been observed either singly or in combination in Cd, Zn, Bi and Sn. No deformation was observed in Zr, Mg, Cu, and Fe. The occurrence of such deformation, in terms of its intensity and initiation pressure, relates directly to the degree of anisotropy in the linear compressibility. Pressure cycling does not significantly affect the residual tensile properties of a Zn alloy which exhibits pressure-induced deformation similar to that of pure Zn. Author

N65-36339# California Univ., Livermore. Lawrence Radiation Lab.
**DEVELOPMENT IN THE FIELD OF OXIDE-BASED CERAMICS [L'EVOLUTION DANS LE DOMAINE DES CERAMIQUES A BASE D'OXYDES]**
H. J. Oel Mar. 1965 17 p refs Transl. into ENGLISH from Bull. Soc. Franc. Ceram. (Paris), v. 63, Apr.–Jun. 1964 p 15–25
(UCRL-TRANS-1199(L))

New progress in the field of oxide ceramics is examined. Developments on increasing purity, utilization, sintering and texture, the influence of chemical additives, and the suppression of undesirable properties are discussed. It was concluded that greater use should be made of chemistry in preparing the starting powders. Physical methods of measurement should be used for developing new products; and for the factory control of powders, of shaped articles before and during firing, and of the final products. R.N.A.

**N65-36343#** Philips Gloeilampenfabrieken N. V., Eindhoven (Netherlands). Natuurkundig Lab.

**MAGNETIZATION CURVES AND RESISTANCE TRANSITIONS OF SUPERCONDUCTING LEAD ALLOYS**

Willem Frederik Druyvesteyn (Ph.D. Thesis—Tech. Hogeschool, Eindhoven) [1965] 128 p refs CFSTI: HC $4.00/MF $1.00

Some theories on the magnetic and electrical properties of superconductors are reviewed, and the magnetization curves and resistance transitions of superconducting lead alloys are discussed with emphasis on lattice defects. Null-coil magnetometer, and flux meter observations were used to obtain magnetizing curves of lead alloys in a longitudinal, and in a transverse field. The difference between the two curves was attributed to flux pinning. Resistance transitions of lead-indium alloys were explained in terms of flux motion and of surface superconductivity in high fields. It was found that the magnetization curve approaches its reversible value when the critical transport current is reached for increasing fields as well as for decreasing fields. The various causes of crystal lattice defects were described and their influence on the resistance transition of lead was analysed. G.G.

**N65-36353#** Metallgesellschaft, A. G., Frankfurt am Main (West Germany).

**FURTHER DEVELOPMENT OF THE ZIRCONIUM ALLOY ZrNb3Sn WITH A VIEW TO ITS USE AS CLADDING MATERIAL IN WATER-COOLED NUCLEAR REACTORS Quarterly Report No. 4, 1 Jul.–30 Sep. 1964**

10 Dec. 1964 10 p

(Contracts EURATOM-009-60-4 RDA: EURATOM-047-61-4 RDA)

(EURAEC-1274) CFSTI: HC $1.00/MF $0.50

Comparative corrosion tests in steam at 400° and 450° C on ten ZrNb3Sn alloys with additions of iron, chromium, copper, vanadium, and antimony, were continued and a test time of 1970 hrs reached. Results show that, in all cases, tin has an adverse effect on weight increase. Elongation decreases after 500- to 700-hrs owing to corrosion. In short term hot tensile tests at 450° C the drop in the niobium content invariably led to lower strength values than in ZrNb3Sn. Creep tests on the same alloys at 450° C revealed that alloys containing antimony, vanadium, and chromium; and those containing iron and tin, were superior to the reference alloy ZrNb3Sn. A higher creep elongation was noted in tin-free alloys containing iron and copper. S.C.W.

**N65-36410#** Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment.

**THE BEHAVIOUR OF ZIRCONIUM ALLOYS IN SANTOWAX OM ORGANIC COOLANT AT HIGH TEMPERATURES Interim Report, Jan. 1961–Oct. 1963**

A. Sawatzky Oct. 1964 48 p refs

(AECL-2118) CFSTI: HC $2.00/MF $0.50

Zirconium alloys have been exposed to Santowax OM at temperatures of 320 to 400° C for times as long as 5000 hours. Short-term experiments (less than 2 weeks) were done in stainless-steel bombs and small out-of-pile loops. The X-7 organic loop in the NRX reactor was used to study long-term oxidation and hydriding both in-flux and out-of-flux. The results obtained lead to several tentative conclusions: (1) Aluminum cladding serves as an effective hydrogen barrier. (2) Considerable protection against hydriding is given by zirconium oxide, provided impurities in the organic are carefully controlled. (3) Hydriding is greatly enhanced by the presence of chlorine in the coolant. (4) Hydriding is somewhat enhanced by neutron irradiation. Of considerable significance is the fact that a Zircaloy-4 in-reactor test section of the X-7 loop was exposed to Santowax OM at 320 to 400° C for more than 5000 hours without excessive hydriding. Author

**N65-36446#** Oak Ridge National Lab., Tenn.

**HIGH TEMPERATURE CREEP OF NICKEL-TUNGSTEN ALLOYS**

Kaizo Monma, Hajime Suto, and Hiroshi Oikawa [1964] 7 p refs Transl. into ENGLISH from J. Japan Inst. Metals (Sendai City), v. 28, 1964 p 304–307

(ORNL-TR-552)

Tensile creep properties of nickel tungsten alloys containing up to about 10 at % of tungsten have been studied. Tests were carried out in argon atmosphere over the temperature range from 750° C to 1200° C and the stress range from 14 to 9 kg/mm$^2$. Steady state creep rate ($\dot{\epsilon}_s$) decreases with the increasing tungsten content. Temperature and stress dependences of steady state creep rate were analyzed using Dorn's equation, $\dot{\epsilon}_s = C\sigma^n \exp(-Q_s/RT)$. Activation energies ($Q_s$) are independent of applied stresses. They increase with the tungsten content from 66 kcal/mol for pure nickel to the maximum value of 84 kcal/mol for the alloy of 5 at %-tungsten, before they decrease with further increase of the tungsten content. Stress exponents (n) increase extremely with the tungsten content from a value of 5.0 for pure nickel for the maximum value of 7.2 for the alloy of 1.7 at % tungsten. Whereas, in alloys containing more than this concentration of tungsten they decrease with the increasing content of tungsten to values less than that for pure nickel. Author

**N65-36448#** Oak Ridge National Lab., Tenn.

**EFFECTS OF PYROLYTIC-GRAPHITE STRUCTURE ON DIFFUSION OF THORIUM**

Frederick Libben Carlsen, Jr. Jun. 1965 55 p refs

(Contract W-7405-ENG-26)

(ORNL-TM-1080)

Diffusion coefficients for thorium in pyrolytic-graphite specimens having a wide range of structural properties in the 1850° C to 2000° C temperature range were determined. The specimens included pyrolytic graphites from two sources, both as-deposited and heat treated at temperatures of 2200° C to 2700° C for times of one to four hours, and a pyrolytic graphite that was previously hot pressed at 3000° C. Interlayer spacing, crystallite size, prefered orientation of crystallites, microstructure, and porosity, were also investigated. Results indicate that the diffusion coefficient of thorium in pyrolytic graphite is dependent upon the concentration of thorium and the structure of the graphite; that the diffusion coefficients for *a*-direction diffusion depend upon the number of microcracks present in the material, that structural changes that occur during heat treatments at temperatures above 2900° C or hot pressing at 3000° C significantly reduce the diffusion coefficient for *c*-direction diffusion; and that diffusion coefficients are not reduced by heat treatments up to 2700° C for the graphite materials used even though significant structural changes occurred upon heating at 2700° C for 2 1/2 hours. L.S.

**N65-36482#** California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.

**THE STRUCTURE OF γ PHASE IN THE NIOBIUM–TIN SYSTEM**

T. R. Anantharaman Mar. 1965 8 p refs *Its* AEC Res. and Develop. Rept. No. 33

(Contract AT(04-3)-221)

(CALT-221-8)

The lattice spacings of the gamma phase obtained from a Nb–Sn alloy were examined and excellent agreement was found between experiment and theory on the basis of a face-centered tetragonal unit cell. An ordered superstructure made up of 64 niobium unit cells was suggested by the indices of the strong X-ray reflections and by the nature of the absent reflections which are tabulated. The atomic volume also showed striking agreement with 128 atoms in the face-centered tetragonal unit cell. The tetragonal gamma phase on the basis of these data is assigned the formula $Nb_9Sn_7$ and the composition 43 to 44 percent tin. E.E.B.

N65-36509# Oak Ridge National Lab., Tenn.
**TYPE 316 STAINLESS STEEL, INCONEL, AND HAYNES ALLOY NO. 25 NATURAL-CIRCULATION BOILING-POTASSIUM CORROSION TEST LOOPS**
D. H. Jansen and E. E. Hoffman Jun. 1965 55 p refs
(Contract W-7405-ENG-26)
(ORNL-3790) CFSTI: $4.00

An investigation was undertaken to determine the compatibility of conventional nickel-, iron-, and cobalt-base high-temperature alloys with boiling potassium. The tests were designed to obtain quantitative information on the dissolution of the container alloys by condensing potassium and the subsequent deposition of solute in a subcooled liquid region of the test device. Studies were conducted in natural-circulation loops, two of which were fabricated from type 316 stainless steel, two from Haynes alloy No. 25, and one from Inconel. Each of the alloys was operated at a maximum boiler-condenser temperature of 870° C for 1500 to 3000 hr, and the Haynes alloy No. 25 was also tested for 3000 hr at 980° C. The potassium condensing rates at the two temperatures were 170 to 180 and 300 g/min, respectively. At 870° C type 316 stainless steel and Haynes alloy No. 25 exhibited comparable resistance to attack by boiling potassium, while Inconel showed greater deterioration. Author

N65-36511# National Academy of Sciences—National Research Council, Washington, D. C. Materials Advisory Board.
**MATERIALS ADVISORY BOARD COMMITTEE ON BERYLLIUM METALLURGY Third Progress Report, Sep. 1964–May 1965**
1 Jun. 1965 24 p
(Contract ARPA SD-118)
(MAB-199-M(3))

Abstracts of papers given at a meeting of the Committee on Beryllium Metallurgy emphasizing beryllium purification and structural application are presented. Improved ductility and toughness through new processes of beryllium purification is the subject of the majority of the papers summarized. Also included is a listing of research projects on beryllium studies. G.A.L.

N65-36517# Commissariat a l'Energie Atomique, Paris (France).
**THE USE OF BERYLLIUM AS CANNING MATERIAL PROBLEMS ARISING FROM THE BRITTLENESS OF THE METAL, AND THEIR CURRENT SOLUTION [L'UTILISATION DU BERYLLIUM COMME MATERIAU DE GAINE LES PROBLEMES POSES PAR LA FRAGILITE DU METAL ET LEURS SOLUTIONS ACTUELLES]**
Michel Weisz, Jose Mallen, Yves Adda, and Jean-Michel Dupouy [1964] 12 p refs Transl. into ENGLISH
(CEA-R-2639; AEC-TR-6556)

The low creep resistance of beryllium tubes to high pressures and temperatures was investigated. Mechanical tests on single beryllium crystals of different purities established that purification did not result in new modes of deformation, but greatly increased the anisotropy of the existing modes. The transverse ductility of tubes made from sintered material remained abnormally low, even when favorable textures were imposed prior to extrusion by preliminary compression. Tubes extruded from cast ingots with a low BeO content by impact, or by a slower rate, showed a much higher plasticity after being maintained for 500 to 1000 hrs at temperatures between 600° and 700° C. Slower extruded beryllium tubes had partially recrystallized grain structures. Tubes extruded from beryllium-calcium alloy possessed similar properties. G.G.

N65-36539# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials.
**CONSTITUTION OF GOLD-GERMANIUM ALLOYS QUENCHED FROM THE MELT**
T. R. Anantharaman, Huey-lin Luo, and William Klement, Jr. Apr. 1965 16 p refs *Its* AEC Res. and Develop. Rept.-34
(Contract AT(04-3)-221)
(CALT-221-9)

Two new metastable intermediate phases have been obtained in gold-germanium alloys by rapid cooling from the melt. One is of the hexagonal close-packed (h.c.p.) structure with near-ideal axial ratio and may be considered a Hume-Rothery phase. The other has a complex tetragonal structure (a = 11.627 Å and c = 22.491 Å for the $Au_{60}$ Ge 40 alloy) and may be looked upon as a superlattice made up of 44 face-centered cubic (f.c.c.) unit cells. Alloys with the latter complex phase are characterized by marked preferred orientation and have been shown to be superconducting. The metastable constitution of the Au-Ge alloys is discussed with reference to the rate of cooling from the melt. Author

N65-36540# General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
**CORROSION RESISTANCE OF CONSOLIDATED ZIRCALOY-2 POWDER CONTAINING OXYGEN AND NITROGEN**
A. E. Bibb, A. P. Beard, and J. F. Fascia Jun. 1964 13 p refs
(Contract W-31-109-ENG-52)
(KAPL-3060)

This report covers work on the corrosion characteristics of consolidated Zircaloy-2 powder containing additions of oxygen and nitrogen. Oxygen (>2700 ppm) and nitrogen (>100 ppm) additions reduced the time to transition in 680 F water and had a deleterious effect on both the 680 F water and 750 F steam corrosion resistance of consolidated Zircaloy-2 powder. Linear relationships for hydrogen weight gains were a function of oxygen weight gains irrespective of whether the data were obtained pre- or post-transition. The data suggest that the hydrogen uptake characteristics are an inherent property of the alloy and depend only on the magnitude of corrosion. Nitrogen reduced the tendency for the Zircaloy-2 to pick up the hydrogen generated in the aqueous corrosion reaction. Author

N65-36607# Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
**INFLUENCE OF LONG RANGE ORDER ON THE MECHANICAL PROPERTIES OF SOLID SOLUTIONS [INFLUENCIA DEL ORDEN DE LARGO ALCANCE EN LAS PROPIEDADES MECANICAS DE LAS SOLUCIONES SOLIDAS]**
Aldo Erwin Vidoz and Maximo Victoria 1965 33 p refs in SPANISH; ENGLISH summary *Its* Informe No. 130
(Contract DA-ARO-49-092-62-12) CFSTI: HC $2.00/MF $0.50

A review is offered on the influence of long range order on the mechanical properties of solid solutions. Some brief ideas about crystaline order and dislocations in ordered structures are previously given to make easier to the reader the understanding of the paper. A critical review is made in which new ideas are introduced. A modification of Vidoz and Brown deformation mechanism is proposed to give more generality to the model. Experimental results are analyzed in detail. Author

**N65-36613#** Argentina. Comision Nacional de Energia Atomica, Buenos Aires.
**PROPERTIES OF A COPPER ALLOY WITH HIGH RESISTANCE TO MELTING AND HIGH CONDUCTIVITY [PROPIEDAS DE UNA ALEACION DE COBRE DE ALTA RESISTENCIA AL ABLANDAMIENTO Y ALTA CONDUCTIVIDAD]**
D. Obrutsky, M. Sarrate, and O. Wortman 1965 13 p refs In SPANISH *Its* Informe No. 146 CFSTI: HC $1.00/MF $0.50

A study was conducted on precipitation in Cu–Zr alloys using hardness, conductivity, thermoelectric electromotive force, dilatometry, X-ray, and cutting tests. It was verified that additions of 0.08% Zr notably raised the temperature of crystallization. At 300° C a sample with 0.08% Zr maintained its hardness for 250 hours. The maximum increase of hardness was observed for agings of 5 min at 500° C. Apparently only one mechanism is responsible for the aging. The precipitated samples present a characteristic Widmanstatten structure. The $Cu_3Z$ isomorphic phase is similar to that of $Cu_3Ti$. The mechanical properties are dependent on orientation and this dependency is great when the Zr content is high. The activation energy for precipitation was established at 23 000 cal/mol. For soluble samples, 75% worked and aged, the mechanical properties are comparable and the conductivity is superior to that of Cu–Cr. Transl. by RN.A.

**N65-36662** Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences.
**EXPERIMENTS ON ANNEALED ALUMINUM**
Marvin Jerry Kenig 1965 162 p refs *Its* Rept.-737
(AFOSR-65-0983; AD-618088)

Tubes of 1100 aluminum are subjected to combined tension and torsion loads. A very slow loading technique using very small load increments is employed. At the conclusion of static testing, specimens are subjected to torsional impulsive loading superimposed upon a biaxial prestress. It is determined that annealed 1100 aluminum is a mechanically unstable material. All of the plastic deformation that will eventually occur locally does not take place during a single impulsive loading. During slow loading, slow "waves" (of the order of $10^5$ times slower than elastic waves) are observed at discrete values of the average stress. All existing commonly used theories of plasticity in solid mechanics cannot possibly apply to mechanically unstable materials. Applying shock wave and Karman-Taylor theory to the experimentally determined quasi-static stress-strain curve for annealed 1100 aluminum accounts for all experimentally observed wave speeds for both fast and slow loading techniques without including strain rate effects. Author

**N65-36666#** Rock Island Arsenal Lab., Ill. Research and Engineering Div.
**MULTIMETAL COATING PROCESS FOR COMPOSITE METAL ASSEMBLIES**
Jodie Doss May 1965 24 p refs
(RIA-65-1137; AD-617196)

Old coatings and corrosion products were removed from composite metal assemblies consisting of aluminum, magnesium and steel without an appreciable attack on the basic metals. The composite metal assemblies were recoated simultaneously with tin coatings while in a stannous pyrophosphate solution or a stannate-pyrophosphate solution. A wash primer was utilized as a coating material for the composite assemblies. Comparative corrosion tests were performed on the above composite metal assemblies. The tin and wash primer coatings on the metal assemblies inhibited corrosion. The recoated metal assemblies did not have the corrosion resistance of assemblies that had been coated prior to the combining of the metals into composite assemblies. Author

**N65-36739#** Rock Island Arsenal Lab., Ill. Research and Engineering Div.
**ANODIC PASSIVATION OF STAINLESS STEEL**
Linden H. Wagner May 1965 48 p refs
(RIA-65-1190; AD-619152)

Cathodic activation, anodic and immersion passivation treatments on types 310, 321, 410 stainless steel panels, and M1 gas cylinders were investigated in 5% solutions of $Na_2SO_4$, $Na_2Cr_2O_7$. Passivation in 20% $HNO_3$ containing 2% $Na_2Cr_2O_7$ was conducted as described in MIL-STD-171A. A Sargent Recorder, Model MR, an automatic self-balancing potentiometer, was used to measure potentials with reference to a normal Calomel-cell and a salt bridge in contact with a stainless steel panel in an auxiliary vessel containing 0.001N NaCl. Potential vs. time measurements were plotted graphically to show the effects of the treatments on the stainless steels. Passivation treatments increased the positive potential; activation increased the negative potential; half-cell potential measurements showed a decay in panel potential vs. time in air exposure. Passivated panels in salt spray exposure afforded slightly better protection than the control panels. Passivated panels in outdoor exposure showed no appreciable difference between the types of stainless steels in the prevention of corrosion. Author (TAB)

**N65-36740#** Naval Research Lab., Washington, D. C.
**A STUDY OF THE INSTABILITY OF NOBLE METAL THERMOCOUPLES IN VACUUM**
B. E. Walker, C. T. Ewing, and R. R. Miller 10 May 1965 12 p refs
(NRL-6236; AD-620322)

Thermoelectric instabilities of noble metal thermocouples and individual thermoelements (platinum, rhodium, iridium, and platinum-rhodium and iridium-rhodium alloys) have been studied in vacuum in the temperature range 800° to 1600° C. These studies are an extension of previous work performed in oxidizing and neutral atmospheres. As in that work, the principal source of instability was found to be contamination of the thermo-elements by iron impurities from ceramic protection tubes. Iron contamination had a maximum effect on instability in Pt and the alloys but was less important for Ir and Rh. Thermocouple errors associated with this contamination in vacuum were compared with the previous data in air and argon, and the instabilities in vacuum were found to be comparable with those found in argon. The instabilities found for couples in argon and vacuum environments were of much greater magnitude than those found in air. Criteria have been set forth for the use of noble element thermocouples. Important among these are the use of low-iron-content sheathing and large-diameter elements. Author (TAB)

**N65-36776*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**CURRENT STATUS AND OPPORTUNITIES FOR IMPROVED HIGH-TEMPERATURE MATERIALS FOR ADVANCED TURBULENT ENGINES**
G. Mervin Ault Washington, NASA, 1965 48 p refs Presented at Intern. Meeting on Aircraft Design and Technol., AIAA, Los Angeles, 15–18 Nov. 1965
(NASA-TM-X-52138) CFSTI: HC $2.00/MF $0.50 CSCL 11F

The status of the development of conventional superalloys of nickel and cobalt base, and other improved high temperature materials used for fabricating the hotter components of turbojet engines, are reviewed. Stress, strength, temperature capability, and receptability of the materials to coatings are considered. Other candidate materials such as chromium, tantalum, and niobium alloys, fiber-reinforced superalloys, intermetallic materials (beryllides), and dispersion-strengthened superalloys are discussed. Compositions of the various alloys discussed are tabulated, and several comparison graphs of cobalt, nickel base, and dispersion-strengthened alloys are given. Also presented are strength curves for the other various alloys considered. L.S.

**N65-36803#** Joint Publications Research Service, Washington, D. C.
**ON THE STRENGTH OF WELD JOINTS FROM HIGH-STRENGTH STEELS**
A. M. Makara 19 Oct. 1965 20 p refs Transl. into ENGLISH from Novyye Probl. Svarochn. Tekhn. (Kiev), 1964 p 247–265
(JPRS-32460; TT-65-32939) CFSTI: $1.00

The problem of obtaining strength-similarity in welded joints from high-strength steels is analyzed in terms of previously obtained experimental results. It is concluded that solution of the weldment problems will be based upon combining the maximum possible hardening obtained by metallurgical means and welding technology, with increased structural strength of the joints. G.A.L.

**N65-36823#** Battelle Memorial Inst., Columbus, Ohio. Columbus Labs.
**RADIATION STABILITY OF URANIUM MONONITRIDE**
Robert L. Martin, William J. Zielenbach, Victor W. Storhok, Donald L. Keller, and John E. Gates 29 Jun. 1965 33 p refs (Contract W-7405-ENG-92)
(BMI-1731; EURAEC-1431) CFSTI: $2.00

The irradiation characteristics of UN fabricated by various techniques and clad with Type 316L stainless steel were studied at surface temperatures up to about 759 C and fission burnups to 6.3 a/o ($2.2 \times 10^{21}$ fissions per $cm^3$) of the uranium. Diametral swelling of clad specimens varied from 1.3 to 4 percent. No clear-cut relationships between swelling characteristics and fabrication technique were observed. Fractional fission-gas releases ranged up to 26 percent. Hydrogen resulting from $N^{14}(n,p)C^{14}$ reaction was almost totally released from the UN but significant fractions were retained within soundly clad specimens. About half of the stainless steel claddings exhibited very small cracks of unknown origin. Author

**N65-36843#** Frankford Arsenal, Philadelphia, Pa.
**DETERMINATION OF INTERFACIAL ENERGIES BETWEEN SOLID COPPER AND BINARY BISMUTH-THALLIUM LIQUID METAL COMPOSITIONS**
Bernard J. Rogus Jul. 1965 22 p refs
(R-1769; AD-619193)

Interfacial energies were determined at 1250° F, 950° F, and 650° F between solid copper and binary bismuth-thallium liquid metal alloys. Interfacial energies were determined between the copper and the liquid metal environment as the relative proportions of bismuth and thallium in the liquid metal were varied. Results showed that progressive additions of thallium to bismuth raises the interfacial energies between the resulting liquid metal environments and the solid copper. Interfacial energy values calculated for 1250° F ranged from 278 ergs/$cm^2$ for a liquid metal composition of 100 percent bismuth to 360 ergs/$cm^2$ for a composition of 100 percent thallium. Interfacial energies between solid copper and liquid bismuth-thallium environments increase as the temperature decreases in the range of 1250° F to 650° F. The effect of thallium on increasing the interfacial energy becomes more pronounced as the temperature decreases. Author (TAB)

**N65-36864#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**DETERMINATION OF THE INDUCTION HEATING TIME OF TITANIUM ALLOY BILLETS FOR PRESSURE WORKING**
I. I. Bezruchko and M. S. Aysikovich 21 May 1965 18 p refs Transl. into ENGLISH from Kuznechno-shtampovochnoye Proizv. (USSR), no. 12, 1963 p 27–31
(FTD-TT-65-427/1+2; AD-466200)

This article deals with the problem of experimentally determining the induction heating time for billets of one titanium alloy. Investigations carried out on the induction heating of IMP 2 titanium-alloys billets have made it possible to reveal the heating characteristics, establish the nature of distribution of thermal fields in cross sections of a billet, determine the heating time of billets for various temperature limits along their cross section, and a number of other important parameters. Author (TAB)

# 18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

**N65-35808#** California Inst. of Tech., Pasadena. Graduate Aeronautical Labs.
**THE MECHANICAL AND OPTICAL CHARACTERIZATION OF SOLITHANE 113 AND INVESTIGATION OF OPTICAL LAG IN PHOTOVISCOELASTIC ANALYSIS Technical Report, 1 May 1963–31 Aug. 1964**
M. L. Williams, W. M. Beebe, C. W. Ferguson, and R. J. Arenz Kirtland AFB, N. Mex., AF Weapons Lab., Mar. 1965 70 p refs
(Contract AF 29(601)-5367)
(GALCIT-SM-64-42; WL-TR-64-155; AD-616344)

A complete mechanical and optical characterization is given for Solithane 113, a urethane rubber compound having high birefringent sensitivity and excellent optical transmission properties. Its viscoelastic transition region is found to span about six decades of logarithmic time, somewhat narrower than other materials of the urethane family. The time-dependent orientation of the principal mechanical axes and optical

axes is investigated for a circular Solithane specimen subjected to a rapidly changing diametric load situation. The results indicate the possibility of large phase lag of the optical axes orientation compared to principal stress axes. The agreement with principal strain axes is generally much closer but even here the phase angle can be as much as 45° Author

**N65-35901#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**SITALLS, THE NEW INORGANIC MATERIAL IN MODERN TECHNOLOGY**
N. A. Toropov 19 May 1965 10 p refs Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 10, 1963 p 43-46
(FTD-TT-65-58/1; AD-618648)

The problem of creating sitalls (devitric ceramics or pyroceramics) of the new class of glass-crystal materials which are very valuable because of their outstanding physical and chemical properties, has peculiarly important scientific and technical significance. Sitalls possess high resistance to fire and heat, stand up well under sharp changes in temperature, and are distinguished by their hardness and high mechanical strength, as compared with glass. They are characterized by splendid electrical insulation properties. The low density in connection with the high mechanical indices makes it possible to use them in a number of cases as very effective building material. Author

**N65-35903#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EFFECT OF OXYGEN AND OXIDATION INITIATORS (HYDROPEROXIDE) ON ANTIWEAR AND ANTIFRICTION PROPERTIES OF POLYSILOXANES**
G. V. Vinogradov, N. S. Nametkin, and M. I. Nosov 6 Jul. 1965 14 p refs Transl. into ENGLISH from Neftekhimiya (USSR), v. 4, no. 3, 1964, p 510-517
(FTD-TT-65-315/1+2+4; AD-618010)

Investigated was the effect of oxidizability of gaseous phase, introduction into polysiloxane liquids of oxidation initiators (hydroperoxide of isopropylbenzene) and easily oxidizing hydrocarbon (4,4'-diisopropyldiphenylmethane) on the lubricity of polysiloxanes of various nature under heavy boundary friction conditions. Although oxidizers produce a weak effect on the lubricity of polysiloxanes in comparison with what has been observed for petroleum oils, but the trend and direction of this effect in all instances is identical—oxidizers and easily oxidizing hydrocarbons delay the development of steel sticking, make it degenerated and promote its breaking away. The effect of oxidizers and easily oxidizing hydrocarbons on lubricity of polysiloxanes increases with a reduction in thermo-oxidizing stability of the latter. Antifriction properties of polysiloxanes are more sensitive in comparison with antiwear properties with respect to the gaseous phase and composition of lubricants. Author

**N65-36191#** Coating and Chemical Lab., Aberdeen Proving Ground, Md.
**ANALYSIS OF POLYAMIDE AND AMINE ADDUCT RESINS Final Report**
James R. Keiser 6 Aug. 1965 12 p refs
(CCL-185; AD-620544)

Polyamide and amine adduct resins are widely used as coreactants with epoxy resins in two-package coating systems. No methods for the analysis or characterization of polymers of this type appear in the literature. This report describes a method for hydrolysis of these curing agents that permits quantitative separation and identification of the fatty acid or dimer acid constituents. Author

**N65-36242#** Naval Research Lab., Washington, D. C.
**THE EFFECTS OF A JET FUEL ANTI-ICING ADDITIVE ON FUEL TANK LININGS**
G. E. Rohl and J. E. Cowling 19 Jul. 1965 9 p refs
(NRL-6276; AD-620170)

A study was conducted on the effects of a jet fuel anti-icing additive, consisting mainly of methyl cellosolve, on fuel tank linings. Test panels coated with various lining materials were immersed for 12 months in a water-fuel mixture containing the anti-icing additive in progressively increasing amounts, ranging from 0 to 100% in the aqueous phase. Results indicate that there is significantly less blister formation, both in size and density, of linings exposed to 20 to 40% concentrations of anti-icing additive than of linings exposed to higher and lower concentrations. The concentration limits which the additive would reach in water in normal service are in the 20 to 40% range. R.N.A.

**N65-36308#** Whittaker Corp., San Diego, Calif. Narmco Research and Development Div.
**OPTIMUM FILAMENT DIAMETER Annual Report (Supplementary Report)**
B. Levenetz 25 Dec. 1964 24 p
(Contract NObs-86347)
(AD-609695)

Presented are reports on the theoretical advantages of large diameter fibers, tested properties of large diameter fibers, strength limitation by matrix material, evaluation of the sandwich cylinder test, and comparison of candidate materials. R.W.H.

**N65-36319#** Naval Research Lab., Washington, D. C. Organic and Biological Chemistry Branch.
**STUDIES TO IMPROVE THE WEAR DURABILITY OF POLYTETRAFLUOROETHYLENE (TEFLON) COATINGS ON ELASTOMERIC VULCANIZATES**
A. G. Sands and E. J. Kohn 30 Jul. 1965 20 p refs
(NRL-6298; AD-620355) CFSTI: $1.00

Methods for improving the wear durability of polytetrafluoroethylene (TFE) coatings on vulcanized elastomeric substrates have been investigated. A high-temperature flame-sintering technique has been developed which substantially improves the abrasion resistance of the TFE coatings, even in contact with rough surfaces such as 12-oz duck canvas. The flame-sintered TFE coatings exhibited a high order of durability in contact with smooth steel and anodized aluminum surfaces. Nonanodized aluminum surfaces were severely abraded by the TFE coatings. The flame-sintering treatment did not appreciably degrade the physical properties of most of the elastomers studied, nor did it adversely affect the frictional properties of the TFE coatings. Stabilizers utilized in gum neoprene and acrylonitrile elastomers tended to interfere in the adhesion of the TFE coating, but cleaning the surface of the vulcanizate with an aromatic solvent prior to application of the coating improved the adhesion. The addition of colloidal boehmite alumina to the aqueous TFE dispersion significantly improved the abrasion resistance of sintered TFE coatings on elastomeric vulcanizates. Self-healing of cracks characterizes these coatings, which accounts in part for the improved wear resistance. Where cracks were present in coatings not containing this additive, peeling of the

coating from the substrate was initiated at the edges of the cracks by abrasive wear. The TFE and sintered TFE coatings were comparable in frictional properties but greatly superior in abrasion resistance to a proprietary TFE-filled-resin dry lubricant developed especially for application to rubber items. Author

N65-36525# Minnesota Univ., Minneapolis.
**EFFECTS OF ATOMIC IRRADIATION AND OF MOLECULAR ORIENTATION ON THE MECHANICAL BEHAVIOR OF LINEAR HIGH POLYMERS Final Technical Report**
C. C. Hsiao Feb. 1965 79 p refs
(Contract AT(11-1)-532)
(TID-21874)

A systematic theory of mechanical behavior of macroscopically deformed and microscopically oriented polymer systems as affected by molecular orientation is presented. Orientation induced anisotropy and strength, molecular orientation and strength, fracture strains, simplified theory of strength, state of stress and strength of oriented solids, theory of strength of branched polymeric systems, and reactor irradiation and strength of oriented polymers are discussed. E.E.B.

N65-36541# California Univ., Livermore. Lawrence Radiation Lab.
**MECHANICAL STRENGTH AND FIRE CHECKING CHARACTERISTICS OF HIGH EFFICIENCY PARTICULATE FILTERS**
Kenneth D. Mulcaster Jun. 1964 14 p Transl. into ENGLISH from Staub (Düsseldorf), v. 23, 1963 p 64–69
(UCRL-TRANS-1085(L))

The mechanical strength properties were investigated by (1) checking a dust-loaded filter with strongly pulsating rate of air flow; (2) checking with a super-abundant injection of water into the air being admitted into the filter; (3) vibration and shock testing; and (4) testing with strongly fluctuating temperatures. These tests were conducted on a high-temperature resistant, high efficiency particulate filter with glass paper-filter medium, aluminum spacers, steel frames, and heat-resistant cement sealing. In addition to the mechanical stresses the high efficiency filters in ventilating systems can also be exposed to flame effects which impair their performance capability. Prefilters and prefilter-combinations were studied as protection for these particulate filters. It was shown that with a certain combination of such prefilters, an almost complete fire protection of the main filter can be maintained. A new method for quick, accurate, and reproducible testing with the photoelectric sodium chloride flame test is also described. E.E.B.

N65-36558*# IIT Research Inst., Chicago, Ill. Technology Center.
**DEVELOPMENT OF SPACE-STABLE THERMAL-CONTROL COATINGS (PAINTS WITH LOW SOLAR ABSORPTANCE/EMITTANCE RATIOS) Triannual Report**
G. A. Zerlaut and B. H. Kaye 23 Feb. 1965 36 p refs
(Contract NAS8-5379)
(NASA-CR-67559; IITRI-C6014-21) CFSTI: HC $2.00/MF $0.50 CSCL 11C

Several zinc oxide-pigmented methyl silicone paints and a rutile titania-pigmented polyvinylidene fluoride were irradiated with ultraviolet for 2000 ESH (10X) in a space simulation test. The results of this test are given in tabular form. Absorption spectra measurements (optical density in the ultraviolet and visible regions) were made on various paint constituents. Particle size distribution analyses conducted on various zinc oxide-pigment slurries are included. A polydimethylsiloxane synthesis and photolysis experiment is discussed. C.T.C.

N65-36591# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**METHOD OF REINFORCING RUBBER**
L. V. Kosmodem'yanskiy, E. G. Lazaryants et al 25 Aug. 1965 4 p Transl. into ENGLISH from Soviet Patent No. 166132 (Appl. No. 773821/23-4, 13 Apr. 1962) 2 p
(FTD-TT-65-501/1+4; AD-620764)

The object of the invention is a method of reinforcing rubber with synthetic resins, characterized by the fact, that for the purpose of increasing the heat resistance of vulcanizates, dimethylbutadienestyrene resins are used. Author

N65-36673# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**STUDYING THE CONDITIONS OF MANUFACTURING GLASS FIBERS WITHOUT SURFACE DEFECTS**
L. K. Izmaylova and G. M. Bartenev 19 May 1965 14 p refs Transl. into ENGLISH from Steklo i Keram. (Moscow), no. 3, 1964 p 12–16
(FTD-TT-64-1172/1+2; AD-618641)

Investigations showed that glass fiber, handled with precaution to eliminate mechanical damages, and tested within 1 to 2 minutes after its manufacture, has high strength qualities which exceed the strength of fibers possessing the same glass composition. To study the effect of temperature of the glass mass in the vessel on the strength of industrial glass fiber with all other parameters being constant, draw plates of various lengths were used. The strength of a 10-micron glass fiber dependent upon the rate of drawing was also investigated, and no noticeable change in strength was observed. It was noted that the thermal regime of the under tray zone does affect the magnitude of the temperature gradient along the profile of the bulb. Consequently, the formation of the glass fiber was affected largely by outer conditions and temperature conditions of the under draw plate zone. Five groups of draw plates of various configurations were tested. The diameter of the obtained glass fiber was maintained at a constant and equalled 10 μ. To obtain glass fibers without surface defects a series of draw plates of various configurations were investigated, and optimum configuration of a draw plate with a diaphragm was selected. R.W.H.

N65-36780*# IIT Research Inst., Chicago, Ill.
**DEVELOPMENT OF THERMAL RADIATIVE SURFACE COATINGS FOR NASA–LEWIS SPACE SIMULATION CHAMBER Final Report**
John H. Baldrige [1965] 101 p refs
(Contract NAS3-6019; IITRI Proj. C6042)
(NASA-CR-54274; IITRI-C6042-10) CFSTI: HC $4.00/MF $0.75 CSCL 11C

Five black polymeric coatings were tested and found almost equally suitable for use in a space-simulation chamber being built for the NASA–Lewis Research Center. These are Dalvor, a fluorocabron coating, which was the best of the five; Micobond L6X962, a vinyl-modified phenolic coating; a phenolic-modified epoxy coating; and two silicone resin coatings. These coatings were tested for resistance to abrasion, acids, thermal shock, detergents, live steam, optical radiation and nuclear radiation (under high vacuum while at low temperature). Their spectral properties were measured, as were their outgassing rates under high vacuum while irradiated

by ultraviolet light. Their ease of decontamination when contaminated with radioactive fission products was determined. Before these five coatings were selected, many others were screened by a literature search or by one or more of the tests noted above. Author

**N65-36874#** IIT Research Inst., Chicago, Ill. Technology Center.
**FURTHER OBSERVATIONS ON THE BIAXIAL COMPRESSIVE CREEP PERFORMANCE OF FILAMENT WOUND LAMINATES Special Technical Report, 1 Sep. 1964–30 Jun. 1965**
B. W. Abbott and R. H. Cornish Jul. 1965 16 p refs
(Contract NObs-90329)
(IITRI-M6081; AD-466784)

A discussion of results from a continuing study of biaxial compressive creep in filament wound laminates is presented. The status of stress rupture experiments (one of which has been in progress for over two years) using closed end cylinders subjected to constant external pressure are summarized. The results taken from surface bonded strain gages monitored over long periods of time are included and discussed. Author

# 19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

**N65-35818#** Wisconsin Univ., Madison. Mathematics Research Center.
**ASYMPTOTIC SOLUTIONS OF SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS**
W. A. Coppel Mar. 1965 18 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-555; AD-616874)

The paper discusses the asymptotic behavior as $X \to \infty$ of the solutions of equation $(p(x)y')' + q(x)y = 0$, with particular reference to the case $p(x) \equiv 1$. Author

**N65-35880#** California Univ., Berkeley. Operations Research Center.
**SENSITIVITY ANALYSIS IN NETWORKS**
Richard Wollmer Apr. 1965 64 p refs
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-65-8; AD-618750)

A maximum flow network is defined by a set of arcs and a set of points called nodes. Each arc joins two nodes and has associated with it a positive capacity which represents the maximum amount of flow that may pass over it. One of the nodes is designated as the source and another as the sink. From these nodes, arc, and capacities the maximum amount of flow that may pass from source to sink may be calculated. This investigation is concerned with a sensitivity analysis on such networks. Specifically, each arc of the network is assumed to be subject to breakdowns which result in a reduction in its capacity. The problem is to find the greatest reduction in maximum flow possible if n breakdowns occur and to find where these breakdowns must occur for this reduction to result. The methods developed in this report solve this problem for a certain class of networks known as planar networks. Author

**N65-36008*** National Aeronautics and Space Administration, Washington, D. C.
**ON THE CONTINUATION OF THE IDEA OF HEAVISIDE IN THE OPERATIONAL CALCULUS**
*In its* Published Papers on Probl. on the Borders of Theoret. Elec. Eng. and Math. 1965 p 3–31 refs Repr. from J. of the Franklin Inst., v. 276, no. 5, 1963 p 411–440 (See N65-36007 24-10) CFSTI: HC $6.00/MF $1.50

This paper is an extension of the classical methods of operational calculus with respect to theoretical assumptions, as well as to practical applications. The foundations of this method were published by the author in 1957. The paper aims at a uniform treatment of operational methods adopted to different types of problems, such as the solving of differential and difference equations with constant coefficients, Euler equations, difference-differential equations, Bernoulli equations and other nonlinear equations. The presented method is based on the fundamental notions of functional analysis and is a continuation of the idea of Heaviside. Author

**N65-36009*** National Aeronautics and Space Administration, Washington, D. C.
**NUMERICAL OPERATOR METHOD**
*In its* Published Papers on Probl. on the Borders of Theoret. Elec. Eng. and Math. 1965 p 36–101 refs Transl. into ENGLISH from Rozprawy Elektrotech. (Poland), v. 5, no. 4, 1959 p 515–586 (See N65-36007 24-10) CFSTI: HC $6.00/MF $1.50

This paper consists of three parts. In the first part a method is presented for algebraic solutions of difference equations. Elements of the algebra discussed are "numerical operators" constituting a special category of numbers. In the second part, the stability of sampled-data control systems is discussed. The third part concerns a certain numerical method which simplifies the determination of transients in electric systems excited by complex signals. The method is based on the theory presented in the first part of the paper. Author

**N65-36050#** Army Research Office, Durham, N. C.
**TRANSACTIONS OF THE TENTH CONFERENCE OF ARMY MATHEMATICIANS**
Jun. 1965 515 p refs Conf. held at Army Mater. Res. Agency, Watertown, Mass., 10–11 Jun. 1964
(AROD-65-2; AD-466262)

Technical papers are presented on theoretical and applied mathematics. For individual titles see N65-36051–N65-36071.

**N65-36051** Wisconsin Univ., Madison. Mathematics Research Center.
**COMPLEMENTARY VARIATIONAL PRINCIPLES FOR BOUNDARY VALUE PROBLEMS. I: BASIC PRINCIPLES, WITH AN APPLICATION TO ORDINARY DIFFERENTIAL EQUATIONS Technical Summary Report**
B. Noble *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 1–31 refs (See N65-36050 24-19)
(MRC-TSR-473)

In a series of papers a general variational principle and two complementary variational principles are developed for the simultaneous equations $T\phi = \delta W(x,\phi,u)/\delta u$, and $T^*u = \delta W(x,\phi,u)/\delta\phi$, where T, T* are linear operators and T* is the adjoint of T. The resulting formulas are of wide applicability and include most of the complementary variational principles which occur in applied mathematics. In the present paper the implications of the variational principles are worked out in some

detail when T = d/dx, T* = −d/dx, including a discussion of extra terms which are required to deal with general boundary conditions. Author

**N65-36052** Army Electronics Labs., Fort Monmouth, N. J.
**BOUNDS OF SOLUTIONS OF LINEAR DIFFERENTIAL-DELAY EQUATIONS**
Leon Kotin *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 33–38 refs (See N65-36050 24-19)

Presented are the bounds of solutions of the simplest differential-delay equation which reflects the fact that the rate of change of a physical quantity depends on its value at some time in the past rather than on its present value. The initial equation is a normalization of the general first-order linear homogeneous equation of the retarded type with p(x) > 0 and with one delay; a change of scale results in a similar equation with a unit delay; and a substitution is made so that there is no loss in generality in considering the simpler equation. A series of theorems is offered in relation to the theory of control systems. M.W.R.

**N65-36055** C-E-I-R, Inc., Dugway, Utah.
**MATHEMATICAL PROBLEMS ARISING IN THE DESIGN AND EVALUATION OF AUTOMATIC COUNTING DEVICES**
Floyd I. John *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 91–103 refs (See N65-36050 24-19)

Basic problems of detection, enumeration, and interpretation are discussed in relation to design and evaluation of automatic counting devices. The formulation of mathematical models for counters is considered for certain special cases and for generalization to fit a large class of counters. A stochastic model for expected counts is included, and the expected count is obtained for regular and spiral scan patterns with circular particles. M.W.R.

**N65-36056** Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
**ON THE NUMERICAL ANALYSIS OF THE NONLINEAR AXISYMMETRIC EQUATIONS FOR SHELLS OF REVOLUTION**
John F. Mescall *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 105–122 refs (See N65-36050 24-19)
(AMRA-TR-64-20)

A numerical procedure for obtaining solutions to the nonlinear equations for shells of revolution is described and applied to the problem of a spherical shell under a concentrated load at the apex. Boundary conditions corresponding to an unrestrained edge and a clamped edge are examined and the results compared with available experimental data. Author

**N65-36057** Watervliet Arsenal, N. Y. Research Div.
**LARGE DEFLECTIONS OF COLUMNS OF VARIABLE FLEXURAL RIGIDITY**
R. G. Bhandari, J. J. Pascale, M. J. Pascual, and S. D. Beck *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 123–143 refs (See N65-36050 24-19)

A series solution of the governing differential equations for large deflections of columns of variable flexural rigidity is used to approximate the load-deflection relationship. The required algebraic coefficients of the series are generated on the electronic computer by symbolic manipulation. The numerical results are deduced for various shapes of the exponentially tapered column. Buckling loads for an exponentially tapered column and load deflection relations for a column of constant flexural rigidity are obtained as special cases. These compare well with the existing solutions in the literature. Author

**N65-36060** Aberdeen Proving Ground, Md. Army Ballistic Research Labs.
**OPTIMUM ELLIPSE**
Viola Woodward *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 167–183 (See N65-36050 24-19)

For orientation of air-borne cameras in photogrammetry problems, the sun is photographed as reflected in a mirror and, due to the angles involved, appears on the photographic plate as an ellipse. To get accurate orientation, the equation of the ellipse is needed as accurate as possible. The method described here was devised by applying certain properties of pairs of conjugate diameters of an ellipse: (1) one conjugate diameter bisects the chords parallel to the other conjugate diameter and (2) the product of the slopes of conjugate diameters, with respect to the major axis of the ellipse, is equal to minus the square of the ratio of the minor to the major axes ($-1/R^2$). Author

**N65-36063** Army Chemical Center, Edgewood, Md.
**A TECHNIQUE FOR APPROXIMATING CONTINUOUS DISTRIBUTION FUNCTIONS**
Joseph S. Tyler *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 48 p refs (See N65-36050 24-19)

In order to determine the frequency function of the random variable D from a knowledge of the first four moments about the origin, an iterative technique is developed for approximating continuous distribution functions. The four moments are used to specify the particular Pearson functional form and its parameters; successive improvements are achieved for this approximation by applying a modified version of the classical method for representing continuous functions by orthonormal polynomials. The method used to measure the error associated with the classical or formal expansion of continuous bounded functions is applied to demonstrate the convergence of the technique or iterative scheme for approximating frequency function. M.W.R.

**N65-36064** Aberdeen Proving Ground, Md. Army Ballistic Research Labs.
**TRAJECTORY INDICATOR AND POLYHEDRA**
Serge J. Zaroodny *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 237–283 refs (See N65-36050 24-19)

A rigorous second-order theory is presented for octahedron in orientation other than the indeterminate; redundant data is treated statistically. Treatment for the cube and icosohedron is less developed. The theory is applied to the trajectory indicator which refers to a device able to determine the trajectory of a passing bullet in order to indicate the location of the gun which has fired the bullet. Coordinate systems are discussed, and a single time delay is considered. The symmetry of the triplets and the octahedral array are analyzed. Complete arrays and the icosohedron are discussed, and other methods for obtaining the data are mentioned. M.W.R.

**N65-36065** Army Engineer Waterways Experiment Station, Vicksburg, Miss. Electronic Computer Branch.
**A MATHEMATICAL METHOD FOR BLENDING AGGREGATES FOR A DESIRED GRADATION**
Donald Neuman *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 285–304 (See N65-36050 24-19)

A partial mathematical solution is presented for a civil engineering design problem concerned with blending aggregates for a desired gradation. Theoretical development is presented for the solution and typical aggregate grading chart and problem solution are graphed. A gradation bar chart plots the percent retained on each sieve versus the sieve number and presents the normal distribution curve for the material. This curve is used to define each of the available materials as well as the design mix. A series of algebraic equations is then written to define the physical system or the mathematical model; and this mathematical development is detailed. M.W.R.

**N65-36066** Army Electronics Labs., Fort Monmouth, N. J.
**PARTITIONS OF DISCRETE INFORMATION SPACES WITH SOME SYSTEMS APPLICATIONS**
Erwin Biser *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 305–359 refs (See N65-36050 24-19)

The cybernetic and statistical concepts of entropy and correlation can be applied to many systems problems amenable to probabilistic models and can be used to evaluate the degrees of organization and disorganization of systems. An information theoretical model is devised to yield content of a system by partitioning the parameters (system) into mutually exclusive sets (subsystems). Information conveyed by the system is correlated with that from the subsystems, and an extension of Shannon's fundamental inequality is made. Information correlators are devised to measure the degrees of independence and mutual dependence of the parameters by using the consistency of an information space and its underlying probability space; these correlators also measure the degree of connectedness between the subsystems. Basic concepts of information theory, probability spaces, and conditional probabilities are discussed. Systems analysis considers consistent discrete information spaces; systems synthesis is delineated; numerical examples are given; and tables are presented for nested subsystems, and two- and three-partitioned sets. M.W.R.

**N65-36067** Army Cold Regions Research and Engineering Lab., Hanover, N. H.
**THEORY OF PLASTIC POTENTIAL AND CONSTANT COHESION AND CONSTANT FRICTION ANGLE MATERIAL**
Shunsuke Takagi *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 362–400 refs (See N65-36050 24-19)

The theory of plastic potential is not valid for a material called $c\psi$-material (where c is constant cohesion and $\psi$ is constant friction angle) whose yield criterion for plane deformation is the Coulomb yield criterion. The reason for the limitation to the applicability of the theory of plastic potential is clarified in this paper. The following is pointed out: (1) The principal-stress space as a representation of a three-dimensional stress tensor becomes useful when the principal-stress space is treated as a subspace of the six-dimensional space that can accommodate any three-dimensional stress tensor as a vector. (2) Use of the tensor notation in the theory of large deformation yields an interpretation of the Mohr circle that makes the Mohr circle representation of any two-dimensional second-order symmetric tensor that has a pole defined on it as useful as the stress Mohr circle that has a pole defined on it. (3) The plane deformations derived from the Shield yield criterion and the Drucker-Prager yield criterion by use of the theory of plastic potential are a particular case of the general plane deformation of $c\psi$-material. Author

**N65-36068** Aberdeen Proving Ground, Md. Army Ballistic Research Labs.
**CONDITIONAL HIT PROBABILITIES FOR SUBSEQUENT SHOTS AGAINST RECTANGULAR TARGETS**
R. H. Peterson *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 401–419 (See N65-36050 24-19)

Some questions which arise in connection with tank gunnery are the basis for a discussion of conditional hit probabilities for subsequent shots against rectangular targets. The structure of the conditional probabilities is mentioned, and the one-dimensional case is developed, and illustrated. Moment and correlation matrices are indicated; and tetrachoric expansion of the bivariate normal distribution and its integration is shown. A sample printout sheet gives the single and two-hit probabilities and the four associated conditional probabilities. The n-variate tetrachoric expansion and a coded program were found to be satisfactory for three or four rounds, but computing times become too long as the number of rounds increases. In such cases, a code using Hermite-Gauss quadrature is found to be satisfactory. M.W.R.

**N65-36070** Harvard Univ., Cambridge, Mass.
**WELL-SET PROBLEMS, FUNCTION SPACES AND COMPUTING**
Garrett Birkhoff *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 443–464 refs (See N65-36050 24-19)

A well-set problem is defined as one with a single solution which varies continuously with the boundary data. It is shown that if X is any domain of Euclidean n-space, the bounded, continuous functions on X can be made into a Banach space; any real number can be made into such a space by including all Lebesgue square-integrable functions. Fourier's ring and well-set Cauchy problems are discussed, and difference methods are considered for solving boundary value problems via computers with large storage capacity. Numerical solutions provide approximations which are rounded off to a finite number of digits. The Lax-Richtmyer theorem applies to Banach spaces and is the most notable general theorem for difference approximations to well-set Cauchy problems. Physical analogy is discussed in terms of finding approximations to boundary value problems. Since it is difficult to prove convergence by difference approximations, the problem of interpolation and related schemes is investigated. Tempered distributions are considered for treating well-set Cauchy problems and difference approximations in a Banach setting. M.W.R.

**N65-36071** Springfield Armory, Mass.
**DYNAMIC FORMULATION OF COEFFICIENT OF RESTITUTION**
E. H. Jakubowski *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 465–481 refs (See N65-36050 24-19)

A mathematical model is developed to represent the collisions between the barrel extension and either the buffer or receiver in the M-73 machine gun. In order to represent the coefficient of restitution in a dynamic system, a series of differential equations is evolved to present the energy losses due to the coefficient as a continuous function of time. It is

shown that a fictitious damped spring produces energy losses analagous to those produced by the coefficient of restitution, and formulas are developed to evaluate the spring stiffness and viscous damping factors as functions of the coefficient and of impact time. An analog computer program was developed to simulate the collisions and the resulting data were compared with the test data. Any differences in results were attributed to human error in interpreting the recordings. M.W.R.

**N65-36129#** Grumman Aircraft Engineering Corp., Bethpage, N.Y. Grumman Research Dept.

**THE DETERMINATION AND DESCRIPTION OF AIRCRAFT SURFACES WITH THE ANALYTIC GEOMETRY OF QUADRIC SURFACES**

Kolman W. Brand Jul. 1965 28 p refs

(RM-286)

A method of aircraft surface definition which is based on the analytic geometry of quadric surfaces is presented. Closed expressions for surface representation are developed, and are incorporated into a Fortran program which determines the quadric's equations, derivatives, areas, and conic sections. J.M.D.

**N65-36152** Stanford Univ., Calif. Computer Science Dept.

**CONVEX POLYNOMIAL APPROXIMATION**

Bernard David Rudin 4 Jun. 1965 48 p refs

(Contract Nonr-225(37))

(CS23; AD-618214)

Obtaining polynomial approximations for continuous functions or empirical data in such a way that the approximating polynomials are convex in some prescribed interval are considered. The problem arises in connection with data smoothing and was suggested by a problem requiring the calculation of derivatives from data. A theory for treating a class of nonlinear approximation problems is presented which provides a potentially useful generalization of the linear theory. The geometry of a set of polynomials was developed. The problem of convex polynomial approximation on an interval can be reduced to a problem of minimizing a function subject to linear constraints. It was shown that under certain conditions, solutions can only lie on the boundary of a set of constraints. R.W.H.

**N65-36157#** Texas Technological Coll., Lubbock.

**TOPOLOGICAL METHODS APPLIED TO ACTIVE NETWORKS**

Eldred Donald Merkl (Ph.D. Thesis) Aug. 1965 112 p refs

(Contract AF 33(608)-1119)

(AD-620397)

An extension is presented of the topological methods of Feussiner-Seacat and Percival used in analyzing passive electrical networks. Active networks containing one vacuum tube and one transistor are analyzed to obtain the necessary modification of both methods. TAB

**N65-36169#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**A NUMERICAL METHOD IN A TIME OPTIMAL CONTROL PROBLEM**

N. Ye. Kirin 9 Aug. 1965 15 p refs Transl. into ENGLISH from Metody Vychisleniy, Leningrad Univ. (Leningrad), no. 2, 1963 p 67-74

(FTD-TT-65-955/1; AD-620765)

A special form of the necessary and sufficient conditions for the existence of a solution of a problem and a method of successive approximations for finding this solution is proposed with certain generalizations made regarding the character of the limitations on the control function. R.W.H.

**N65-36216#** Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.

**PROGRAMMING UNDER UNCERTAINTY: THE SOLUTION SET**

Roger Wets Aug. 1965 19 p refs *Its* Mathematical Note No. 424

(DI-82-0464)

In a previous paper, descriptions and characterizations of the equivalent convex program of a two-stage linear program under uncertainty were presented. It was proven that the solution set of a linear program under uncertainty is convex; and explicit expressions for this set for some particular cases were derived. The main results of this paper is to show that the solution set is not only *convex* but also *polyhedral*. It is also shown that the equivalent convex program of a multi-stage programing under uncertainty problem is of the form: Minimize a convex function subject to *linear* constraints. Author

**N65-36232#** Wisconsin Univ., Madison. Mathematics Research Center.

**ON MONOSPLINES OF LEAST DEVIATION AND BEST QUADRATURE FORMULAE II**

I. J. Schoenberg May 1965 16 p refs

(Contract DA-11-022-ORD-2059)

(MRC-TSR-569; AD-620106)

A new method of constructing best quadrature formulae is established in the form of a generalization of Rodrigues' formula for Legendre polynomials. Author

**N65-36233#** Wisconsin Univ., Madison. Mathematics Research Center.

**ON THE CONVERGENCE AND STABILITY OF THE EPSILON ALGORITHM**

P. Wynn Jun. 1965 56 p refs

(Contract DA-11-022-ORD-2059)

(MRC-TSR-572; AD-620107)

The $\epsilon$-algorithm is a sequence-to-sequence convergence accelerating transformation. Using the theory of totally monotone sequences, qualitative assertions concerning the nature of the derived sequences are made. Asymptotic estimates for the members of the derived sequences are given for the cases in which the members of the original sequence can asymptotically be represented by means of Newton series or by Dirichlet series. A stability analysis of the $\epsilon$-algorithm is carried out, and a short description of the smoothing effect of this algorithm is provided. Author

**N65-36234#** Wisconsin Univ., Madison. Mathematics Research Center.

**ON THE DISTRIBUTION OF EIGENVALUES FOR AN $n^{th}$-ORDER EQUATION**

J. B. Mc Leod Jun. 1965 38 p refs

(Contract DA-11-022-ORD-2059)

(MRC-TSR-576; AD-620109)

This paper discusses the asymptotic behaviour of the eigenvalues associated with the equation

$$\frac{d^{2n}y}{dx^{2n}} + (-1)^{n-1}(\lambda - x)\,y = 0 \quad (0 \leq x < \infty)$$

and n homogeneous linear boundary conditions at $x = 0$. Work of Turrittin is used on the Stokes multipliers for asymptotic solutions of the differential equation. At the same time, it

is shown how, at least in the case n = 2, this detailed work can be avoided, giving hope for extending these results to more general differential equations. Author

**N65-36235#** Wisconsin Univ., Madison. Mathematics Research Center.
**PARTITIONING AND TEARING SYSTEMS OF EQUATIONS**
Donald V. Steward Jun. 1965 34 p refs
(Contract DA-11-022-ORD-2059)
(MRC-TSR-581; AD-620110)

Algorithms for partitioning and tearing are given. Partitioning refers to partitioning systems of equations, linear or non-linear, into subsets of equations, i.e., blocks, such that the blocks can be solved one at a time sequentially, but that the equations within a block must be solved simultaneously. Tearing refers to identifying dependencies, i.e., the appearance of certain variables in certain equations, such that by special handling of these dependencies blocks can be partitioned into yet smaller blocks. Author

**N65-36238#** David Taylor Model Basin, Washington, D. C. Applied Mathematics Lab.
**EVALUATION OF THE PROBABILITY INTEGRAL TO HIGH PRECISION**
Francis D. Murnaghan Jul. 1965 131 p refs
(Contract NObs-90215(x))
(DTMB-1861; AD-620356)

The "converging factor" for an asymptotic series representing a function f(x) is that number by which the $(N+1)^{st}$ term of the series must be multiplied so that the result of adding this product to the sum of the first n terms will be f(x). This report describes the determination to high precision of this factor for the asymptotic series representing the probability integral. Tables of this factor to 63 decimal places are included for n ranging from 2 to 64. Author

**N65-36252#** Wisconsin Univ., Madison. Mathematics Research Center.
**OPTIMAL REGULATION OF LINEAR SYMMETRIC HYPERBOLIC SYSTEMS WITH FINITE DIMENSIONAL CONTROLS**
David L. Russell May 1965 62 p refs
(Contract DA-11-022-ORD-2059)
(MRC-566; AD-620104)

This paper considers finite dimensional control of a class of linear symmetric hyperbolic systems of partial differential equations. The control criterion is minimization of the energy of the system at a given time T after the exercise of control is begun. We show that the optimal control exists and satisfies a maximum principle. A type of normality condition is discussed. It is shown that a class of boundary value control problems can be treated in this setting. Some numerical procedures are suggested. Author

**N65-36269#** Litton Systems, Inc., Waltham, Mass. Information Sciences Lab.
**MATHEMATICAL STUDY FOR PROPERTY TRANSFORMATIONS Final Report, Mar. 1964–Mar. 1965**
George S. Sebestyen Griffiss AFB, N. Y., RADC, Jul. 1965 138 p refs
(Contract AF 30(602)-3355
(DS-65-002; RADC-TR-65-167; AD-620236)

Inputs to pattern recognition systems are represented by a set of properties. This report considers the problem of transforming property sets by mathematical transformations to obtain a new set of properties to facilitate decision making with systems of lesser complexity. Different mathematical formulations of the measurement selection problem are discussed and criteria for deriving property transformations are developed from information theoretic considerations. Transformations for minimizing the entropy, for maximizing the divergence, and for minimizing the probability of error (under certain constraints) are derived. While the distributions of stimulus classes (after transformation) are indeed made simpler by the transformations derived in this report, the complexity of the transformations casts doubt on the utility of using mathematical transformations to simplify the property space. The tentative conclusion is reached that, for the time being, it is more useful to analyze the property space for its ability to discriminate between stimulus classes. A set of procedural steps and computations are developed for implementing the analysis of chosen property spaces. Author

**N65-36311#** California Univ., Berkeley.
**AGE REPLACEMENT WITH DISCOUNTING**
Bennett Fox (Rand Corp.) Aug. 1965 13 p refs
(Contract Nonr-3656(18))
(ORC-65-22; P-3161; AD-617881)

Age replacement with discounting is considered. For known failure distribution, principal results are for the case when the failure rate is continuous and strictly increasing to infinity. It is also shown what happens for small discount rate. For unknown failure distribution, the minimax strategy is given. Author

**N65-36328#** Wisconsin Univ., Madison. Mathematics Research Center.
**ARCS AND CHORDS, II**
A. S. Besicovitch Jul. 1965 15 p refs
(Contract DA-11-022-ORD-2059)
(MRC-564; AD-620102)

The simple arcs of Hausdorff dimension $h > 1$ are studied from the point of view of the limits of the ratio

$$\frac{\Lambda^h J(v, v')}{|v - v'|^h}$$

as $v' \to v$, where $J(v, v')$ is the arc between v and v'. The bounds of various densities at points of arcs are given. It is shown that in all cases but one the bounds are exact. Author

**N65-36330#** Wisconsin Univ., Madison. Mathematics Research Center.
**AN APPLICATION OF THE "PLK-METHOD" TO CONFORMAL MAPPING AND THIN AIRFOIL THEORY**
J. Weissinger May 1965 26 p refs
(Contract DA-11-022-ORD-2059)
(MRC-568; AD-620105)

It is shown that the Poincaré-Lighthill-Kuo method for rendering approximate solutions to physical problems uniformly valid can be applied to the elliptic partial differential equations of thin airfoil theory for symmetrical airfoils. An example shows that the technique can be used very successfully for numerical computations. D.T.

**N65-36367#** United Kingdom Atomic Energy Authority, Harwell (England). Engineering Div.
**TABLES FOR THE BINARY ENCODING OF ANGLES**
P. A. Newson Jun. 1965 15 p
(AERE-R-4964) HMSO: 2s 6d

Tables are presented to facilitate working with and conversion between shaft position encoder outputs and angles expressed in degree and radian measures. Author

**N65-36384#** Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro. Instituto de Matematica Pura e Aplicada.
**ANALYTICAL AND QUASI-ANALYTICAL VECTORIAL FUNCTIONS AND THE PROBLEM OF THE BERNSTEIN APPROXIMATION [FONCTIONS ANALYTIQUES ET QUASI-ANALYTIQUES VECTORIELLES ET LE PROBLEME D'APPROXIMATION DE BERNSTEIN]**
Leopoldo Nachbin 1964 15 p refs In FRENCH Submitted for Publication *Its* Notas de Fisica Vol. 11, No. 8 CFSTI: HC $1.00/MF $0.50

A general statement of the Bernstein approximation problem is formulated for application in defining a well-balanced vectorial topological space. A system of weighted approximation by polynomials is used as part of the defining procedure, and application is made for the case of quasi-analytic vectorials. Transl. by G.A.L.

**N65-36435 #** Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
**A TABLE OF THE INTEGRALS [FOR THE BESSEL, HANKEL, AND NEUMANN FUNCTIONS OF ORDER ZERO]**
R. T. Compton, Jr. 1 Jul. 1965 32 p refs *Its* Rept.-1691-12 (Grant NsG-448)
(NASA-CR-67492) CFSTI: HC $2.00/MF $0.50 CSCL 12A

Presented are tabulations for the Bessel, Hankel, and Neumann functions of order zero. The results are listed as a function of x, with the value of ø constant for each page of the table. The value of each integral is listed in terms of its real and imaginary parts. The notations used are:

$$IJ(x,\phi) = RE(IJ) + i\,IM(IJ)$$
$$IN(x,\phi) = RE(IN) + i\,IM(IN)$$
$$IH1(x,\phi) = RE(IH1) + i\,IM(IH1)$$
$$IH2(x,\phi) = RE(IH2) + i\,IM(IH2).$$

G.G.

**N65-36467#** Boeing Scientific Research Labs., Seattle, Wash.
**CONVEX POLYTOPES AND LINEAR PROGRAMMING**
Victor Klee Aug. 1964 89 p refs *Its* Math. Note No. 366 (DI-82-0374)

The history and current state of knowledge concerning the facial structure of convex polytopes are reviewed. Definitions and theorems are stated on polytopal d-tuples, polytopal graphs, and paths in polytopes. An account of some unsolved problems, and some connections between linear programming and the subject of convex polytopes, are given. A bibliography of more than 100 publications on convex polytopes is appended. J.M.D.

**N65-36503#** California Univ., Livermore. Lawrence Radiation Lab.
**LOMMEL FUNCTIONS OF IMAGINARY ARGUMENT**
Robert E. Shafer 8 Apr. 1964 8 p refs
(Contract W-7405-ENG-48)
(UCRL-7806)

The inhomogeneous differential equation,

$$z^2\frac{d^2T}{dz^2} + z\frac{dT}{dz} - (z^2 + \nu^2)T = z^{\mu+1},$$

is considered. The solution $T_{\mu,\nu}(z)$ is adopted for the general solution with complex parameters $\mu,\nu$ and complex argument z. C.T.C.

**N65-36651#** Göttingen Univ. (West Germany).
**LINEAR INVARIANT FAMILIES OF ANALYTIC FUNCTIONS, II [LINEAR-INVARIANTE FAMILIEN ANALYTISCHER FUNKTIONEN, II]**
Christian Pommerenke Repr. from Math. Ann. (Germany), no. 156, 1964 p 226–262 refs In GERMAN; ENGLISH summary
(Grant AF-AFOSR-62-198)
(AFOSR-65-1038; AD-617864)

This paper considers normal families M of functions that are analytic, locally univalent, and normalized in the unit disk. These families are assumed to satisfy a certain invariance property. The prime example is the family U of normalized univalent functions. Another example is the family of locally univalent p-valent functions. In the first part, general properties of these families are studied. For instance, the distortion theorems for U can be generalized to the families M. If the family M is of uniformly bounded characteristic (as is U) then a number of geometric properties can be established, several of which are new even for the case U. In the second part, the boundary behavior of functions in M is investigated, using a certain sequence of functions again in M. Several types of boundary behavior are described and studied. Author (TAB)

**N65-36657#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**A NECESSARY AND SUFFICIENT CONDITION OF ONE OPTIMUM PROBLEM FOR A LINEAR DIFFERENTIAL EQUATION WITH DELAY**
I. A. Ozhiganova 20 May 1965 15 p refs Transl. into ENGLISH from Kompleksn. Avtomatiz. Khim. Proizv., Tr. Inst. Khim. Mashinostr. (Moscow), v. 25, 1963 p 172–180
(FTD-TT-65-450/1+2; AD-617658)

A method for establishing the necessary and sufficient condition of optimality of a problem for a linear differential equation with delay, is presented. The problem is reduced to another subsidiary, but equivalent, optimum problem by simple conversion; and the necessary and sufficient condition of optimality for the subsidiary problem is derived by means of well known results for ordinary differential equations. These calculations are then used to find the necessary and sufficient condition of optimality for the original problem. A statement of the original problem is as follows: To find, in a class of permissible equations, that equation u(t) for which the corresponding trajectory x(t) of the differential equation for the law of motion, at a given moment of time t = T assumes a minimum value x(T). The function u(t), which is a solution to the problem is called the optimal control; and the corresponding function x(t), the optimum trajectory. L.S.

**N65-36804#** Purdue Univ., Lafayette, Ind. Dept. of Statistics.
**ON SECOND MOMENTS OF STOPPING RULES**
Y. S. Chow and H. Teicher Oct. 1965 13 p refs *Its* Mimeograph Ser. No. 59
(Grant NSF GP-4590)

Second moments of stopping rules were investigated based on considerations of moments of randomly stopped sums. The considerations are concerned with the variance of stopping rules and the effect of non-zero means on the variance of a randomly stopped sum. Some martingale generalizations of the application of the moments of randomly stopped sums are included. E.E.B.

**N65-36855** Aerospace Corp., El Segundo, Calif.
**TABLES OF FACTORS TO FIND CONFIDENCE LIMITS FOR $\theta$ (MTBF) ASSUMING THE POISSON FREQUENCY DISTRIBUTION**
Josephine Block and Tedd K. Kawata 10 Dec. 1963 7 p ref
(TOR-269(4303)-5; AD-613619)

Tables have been constructed to find upper and lower confidence limits for MTBF (Mean Time Between Failures) at values $\alpha$ = 0.5, 0.2, 0.1, 0.05, and 0.01; and for one-sided lower confidence limits at values $\alpha$ = 0.5; 0.25, 0.1, 0.025, 0.01, and 0.005. The tables should help reliability engineers in more easily computing confidence limits from accumulated test data. Author

**N65-36863#** Polytechnic Inst. of Brooklyn, N. Y. Electrical Engineering Dept.
**A TOPOLOGICAL FORMULATION OF THE N-PORT PROBLEM AND THE SYNTHESIS OF A CLASS OF SINGULAR IMPEDANCE MATRICES**
Charles Louis Suffel Jun. 1965 44 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1269-65; AD-615576)

First, a rigorous, topological treatment is applied to the resistive n-port problem. Formulas are derived for the open-circuit impedance and short-circuit admittance matrices. Properties of these formulas are used to establish sufficient conditions for the realization of the matrices as well as a relationship between the network geometry and the ranks of the matrices. Secondly, Nambier's results are generalized to the case of an n-port with connected port structure. Author

# 20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

**N65-35959*#** Flight Safety Foundation, Inc., New York.
**THE MOUNTAIN WAVE**
Henry T. Harrison Washington, NASA, Oct. 1965 56 p
(Contract NSR 33-026-001)
(NASA-CR-315) CFSTI: HC $3.00/MF $0.50 CSCL 04B

To alleviate problems posed by flight in clear air turbulence (CAT), studies on the mountain wave type of CAT were conducted. Statistics show a higher incidence of rough air at 35 000 feet than at 25 000 at midlatitudes and individual case histories of airline incidents provide convincing evidence that the tropopause zone is the favored one for turbulence. Five case histories of severe to extreme clear air turbulence were presented. All affected jet aircraft and were mountain wave situations. R.W.H.

**N65-36170#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ORIGINATION OF CONDENSATIONS IN SUPERSONIC FLOWS OF RAREFIED GASES**
A. A. Pomerantsev 12 Aug. 1965 11 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), no. 8, 1964 p 59-63
(FTD-TT-65-621/1+2+4; AD-620770)

An explanation is given of the disappearance of molecular condensations in a sharply rarefied gas, which allows one to calculate the heights of appearance of condensations in front of bodies entering a rarefied layer, in which free molecular flows cease. Author

**N65-36194** Miami Univ., Coral Gables, Fla. Radar Meteorological Section.
**THREE DIMENSIONAL ANALYSIS OF A PRECIPITATION-FREE, SEA-BREEZE FRONT BY RADAR, TIROS, VISUAL AND MESOSYNOPTIC DATA**
H. V. Senn and H. P. Gerrish 1965 8 p refs Submitted for Publication Sponsored in Part by Weather Bur. and Army Electron. Labs. *Its* Contrib. No. 549
(AD-619202)

Two precipitation-free radar thin bands, viewed at Miami on October 23 and 24, 1963, while hurricane Ginny was off the northeast coast of Florida, were relatively unique in that they were almost stationary for many hours in the immediate vicinity. These lines existed only in the lowest 1000 ft on the radarscope, and many field observations taken on both sides of the line indicate that they cannot be attributed to birds, insects, or other particulate matter in the atmosphere. The lines were from 30 to 55 miles long and oriented so that major portions were found over the ocean at nearly right angles to the coast. It has been shown that they were precipitation-free and at least one of them was the combined result of a sea-breeze front and the hurricane Ginny circulation. Both the Tiros VII cloud pictures and the radar composites of the hurricane Ginny precipitation pattern confirmed a connection between the thin band and an apparent spiral band tail in the later stages of the thin band's lifetime. Considering the high radar signal strength received from the thin band and the radar refractive geometry for the two radars which viewed the thin band simultaneously but from different sites, it seems most realistic to consider that these were actually ground targets detected at abnormal ranges due to superrefraction. Author

**N65-36689#** Institut Royal Météorologique de Belgique, Brussels.
**SOLAR RADIATION DATA FROM LEOPOLDVILLE, 1953-1962 [DONNEES DU RAYONNEMENT SOLAIRE A LEOPOLDVILLE, PERIODE 1953–1962]**
L. Hostaux and B. Ikwa 1965 44 p refs In FRENCH; ENGLISH summary *Its* Publ., Ser. A, No. 53 CFSTI: HC $2.00/MF $0.50

Observations from 10 year records of solar radiation components in Leopoldville are presented along with a brief analysis of the data. Readings indicate that strong intensity exists between 10 and 14 h; the annual variation occurs in two maximal and two minimal waves; and the maximal waves are not in phase. Transl. by G.A.L.

**N65-36703#** Eidgenössische Technische Hochschule, Zürich. (Switzerland).
**DETERMINATION OF ECHO CROSS SECTIONS OF ICE-WATER MIXTURES AT A WAVE LENGTH OF 5.05 cm [DIE BESTIMMUNG DER RUCKSTREU-QUERSCHNITTE VON EIS-WASSER-GEMISCHEN BEI EINER WELLENLANGE VON 5,05 cm]**
Jürg Joss (Ph.D. Thesis) Basel, Birkhauser AG, 1964 35 p refs In GERMAN; ENGLISH summary Repr. from Z. Angew. Math. Phys. (Berlin), vol. 15, no. 5, 1964 p 509-537
(Rept.-3461) CFSTI: HC $2.00/MF $0.50

Ice-water mixtures having dimensions similar to hailstones were investigated by a small 5.05 cm radar set. Irregularly

shaped snow particles of 9 to 25 mm actual diameter, showed mean cross sections db values similar to those of ice spheres having the same mass. A small water content in spongy ice spheres increased the cross section value to twice that of an equivalent water sphere. It seems feasible that hail may be distinguished from rain by means of an echo intensity limit. Transl. by G.G.

**N65-36794#** Miami Univ., Coral Gables, Fla. Radar Meteorological Lab.
**MESOSCALE STUDIES OF INSTABILITY PATTERNS AND WINDS IN THE TROPICS Third Semiannual Report, 1 Jun.–30 Nov. 1964**
Harold P. Gerrish and Homer W. Hiser Feb. 1965 69 p refs *Its* Rept.-7
(Contract DA-36-039-SC-89111)
(ML-65102; AD-614706)

Iso-echo contoured CAPPI radar data collected manually on 16 July and 28 September, and non-contoured CAPPI data on 1 October 1964 are used to investigate the motions of individual tropical showers at "altitudes" of 10000, 20000, and 30000 ft. The motions at these "altitudes" are tested as possible indicators of wind. Echo-motion shear between "altitudes" is used to illustrate mechanisms by which the showers grow under baroclinic conditions. Vertical profiles of radar reflectivity and precipitation rate from the showers are examined. Reflectivity equations and nomograms for the MPS-4, modified CPS-6B, and WSR-57 radars are presented. The relationship $Z = 300R \exp 1.4$ is used to relate radar reflectivity to tropical rainfall rates. The attenuation problem at a wavelength of 4.7 cm is described and illustrated. Author

# 21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

**N65-36108*** Air Force Systems Command, Inglewood, Calif. Space Systems Div.
**EXPERIMENT D-9, SIMPLE NAVIGATION ON GEMINI IV**
E. M. Vallerie *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 105–119 refs (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

Efforts to develop a manual space navigation and guidance technique which would provide full backup in case of complete power failure, and which could be merged and interfaced with primary automatic systems are reported. A space sextant and a space stadimeter were developed and tested on the Gemini-4 mission to determine their future applicability. Primary concern with the sextant was the field of view necessary to allow the astronaut to readily identify stars. Primary objectives of the experiment focused on: (1) evaluating the man-spacecraft operational suitability of the space sextant, and obtaining quantitative data for accessing the limits of accuracy of the sextant for optical rendezvous type measurements; and (2) studies of various star and horizon phenomena and specific star-to-horizon measurements to obtain data for postflight calculations and accuracy determinations of navigational position. Although an evaluation of the navigational accuracy using the star-to-horizon measurements has not been completed, valuable qualitative data were obtained on the availability of the observable phenomena, which provided the baseline foundation for successful development of purely manual navigation and guidance techniques. S.C.W.

**N65-36438*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**OPERATING PROBLEMS OF THE SUPERSONIC TRANSPORT IN THE AIR TRAFFIC CONTROL SYSTEM**
Michael C. Fischer [1965] 32 p refs Presented at the 10th Ann. Meeting of the Air Traffic Control Assoc., Inc., Los Angeles, 11–13 Oct. 1965
(NASA-TM-X-56850) CFSTI: HC $2.00/MF $0.50 CSCL 17G

Simulation studies of navigational and operational problems in terminal area operations are discussed. The study considers variable sweep and fixed delta-wing supersonic transport (SST) design configurations operating in the airways system under current air traffic control procedures. Results indicate that a reduction in altitude errors in following the sonic boom boundary of the climb profile, as well as a reduction in the pilot's task was accomplished by the use of a flight director programed for vertical flight-path control. Maneuver time and fuel for climbouts of the SST were consistently greater than that provided for in the SST design allowance, as determined from operations in the New York air traffic control system. A preliminary study of tests involving the use of a pictorial navigation display indicated that the pilots could fly specified pictorial display routes with deviations from course of 1 to 4 n. miles. G.A.L.

**N65-36559*#** Space Technology Labs., Redondo Beach, Calif.
**STUDY OF LUNAR LANDING SENSOR PERFORMANCE Interim Report No. 3**
S. D. Kindorf 31 Jul. 1964 110 p refs
(Contract NAS8-5205)
(NASA-CR-67570; STL-8411-6002-RU000) CFSTI: HC $4.00/MF $0.75 CSCL 17G

The evaluation of lunar navigation accuracies attainable by use of altimeter data was conducted by an error analysis computer program. The analysis was based on the use of Kalman filtering techniques to process the altitude data. Essential inputs to the program were nominal flight trajectories, a statistical model of lunar surface irregularities, a statistical model of altimeter thermal noise errors, and a mathematical model of the altimeter tracker dynamics. The trajectories considered were circular orbits and Hohmann ellipse descents. Results indicated that the exclusive use of altitude data can provide a good estimate of vertical position, vertical velocity, and downrange velocity. Also, varactor bias modulation was investigated as a means of achieving transmit–receive isolation. The feasibility of varactor bias modulation as a means of achieving this isolation was demonstrated. Further, other methods of gating, not related to varactor bias modulation, appear feasible in terms of contributing to the total required system isolation. E.E.B.

**N65-36706#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**INFRARED NAVIGATION [INTRAROT-ORTUNG]**
Peter Aemmer (Ph.D. Thesis) Juris-Verlag, 1964 86 p refs In GERMAN
(Rept.-3481) CFSTI: HC $3.00/MF $0.75

Discussed are construction and operating principles of infrared radiation measuring devices that can be used to establish the phase angle of targets in automatic homing flights. The range of this navigation device is determined partly by the energy of the ultraviolet radiation, and partly by the dimensions of the utilized telescopic lens. Transl. by G.G.

**N65-36814#** Joint Publications Research Service, Washington, D. C
**USE OF THE "LORAN A" RADIO NAVIGATION SYSTEM IN SHIP NAVIGATION**
V. Ustimenkov 8 Oct. 1965 5 p Transl. into ENGLISH from Morsk. Flot (Moscow), no. 7, Jul. 1965 p 20–21
(JPRS-32307; TT-65-32797) CFSTI: $1.00

Data are presented which show that changes in the operation of Loran stations take place almost every year. Consequently, in spite of the great convenience and reliability obtained from fixes using the Loran A radio navigation system, it is recommended that ship navigators take such fixes in connection with other observations. Successive observations using the readings of the receiver–indicators and checking the lines of position on a map permit the establishment of changes in the program of Loran stations. For determinations using Loran A the most reliable results are obtained from ground waves. The Loran A pulse system gives good fixes with ground waves in the sea at distances of 450 to 500 miles and with a high accuracy at distances to 250 miles. Also, it is necessary for hydrographic organizations which control navigation to provide data for pulse and phase system corrections to navigators. E.E.B.

# 22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

**N65-35803#** General Electric Co., Pleasanton, Calif. Atomic Products Div.
**DEVELOPMENT AND DEMONSTRATION OF AN ADVANCED SOLID STATE RADIOISOTOPE POWER SUPPLY Technical Documentary Report, Jul. 1961–Sep. 1963**
Apr. 1965 217 p
(Contract AF 33(616)-8256)
(GEST-2023; AL-TDR-64-115; AD-617071)

The results of a research and development program to demonstrate a low power radioisotope electric generator using thermoelectric converters are presented. The basic concept was to develop a "pencil" module of thermoelectric legs with integrated radioisotope fuel pellets at the hot junctions with particular emphasis on hot pressing techniques. The use of hot pressing techniques did not produce truly successful integral interface junctions of thermoelectric material to hot and cold junction components. However, a combination of hot pressing end caps to the thermoelectric legs and use of spring loaded contacts did work. This increased the inherent hot and cold junction contact resistances and resulted in lower generator efficiencies than initially planned. A prototype power generator unit containing 12 thermoelectric modules was assembled and tested. Thulium metal was proven to be incompatible with thermoelectric material and could not be diffusion bonded. A "separable" concept was conceived using Th-170 as the heat source and thin ceramic tubes for alignment purposes. Eleven tests on the power generator were conducted for a total of 1028 hours at peak loading condition. Test data compared favorably to the theoretically calculated performance data. Author

**N65-35862** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**OPTIMUM FORM OF GAMMA RADIATION SHIELD**
V. V. Tokarev and V. I. Tsvetkov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 135–142 refs (See N65-35850 24-23)

The problem of the optimum form of radiation shielding is considered. Cases of linear, disk, and cylindrical sources are presented. A complete solution is obtained which includes the whole range of variation of parameters. C.T.C.

**N65-35992#** Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
**NEUTRON ECONOMY IN FUSION REACTOR BLANKET ASSEMBLIES**
Albert J. Impink, Jr. 22 Jun. 1965 263 p refs
(Contract DA-36-039-AMC-03200(E); NSF GK-57)
(TR-434; AD-619668)

The conceptual design of a blanket assembly for a hypothesized fusion power reactor is considered from the point of view of neutron economy. Containment of a steady-state thermonuclear plasma composed of equal parts of deuterium and tritium in a cylindrical configuration is assumed. Requirements and limitations imposed on the blanket by the plasma and by other components of the reactor system are analyzed, and the conceptual arrangement of a suitable blanket utilizing a refractory metal first wall and fused-salt cooling is presented. Neutron transport and scattering models are compared in terms of applicability to the present problem. Multigroup, multiregion formulations for neutron transport and scattering in various energy regimes are developed; solutions are obtained by a combination of analytical and numerical methods. A multigroup treatment of resonance absorption and scattering is outlined, and a method of calculating approximate absorption cross sections in the resonance energy region is derived. Comparison of theoretical predictions with published experimental measurements in several test cases has been made to determine the adequacy of the models and computational procedures. Author

**N65-35993#** Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
**STUDY OF A THERMONUCLEAR REACTOR BLANKET WITH FISSILE NUCLIDES**
Laszlo N. Lontai (M.S. Thesis) 6 Jul. 1965 111 p refs
(Contract DA-36-039-AMC-03200(E); Grant NSF GK-57)
(TR-436; AD-619670)

The use of fissile nuclides in a fusion power reactor heat-extraction blanket is investigated from the point of view of tritium regeneration and power production. The existence of a stable, steady-state D-T plasma in a cylindrical configuration is postulated. Optimization studies of several blanket configurations show that a blanket with a thin Mo first wall, a narrow, fused $(LiF)_2BeF_2$ first-wall coolant region, and ~50 cm 21% C and 79% fused ($LiF–BeF_2–UF_4$) primary attenuator region with 17 to 27 mole percent $(U^{238})F_4$ and ~50% $Li^6$ enrichment is feasible and practical. The calculated tritium regeneration is adequate. The total heat recovery is approximately twice that in a nonfissile blanket; approximately 90% of the heat is liberated in the primary attenuator region. The heating rate in the first wall and in the coolant region is independent of the $UF_4$ salt composition. The thermonuclear power limit is ~5 $Mw/m^2$ of neutron energy incident on the first wall. The performance of blankets with a $UF_4$ fused-salt coolant region has been found to be marginal; fissioning metallic first-wall configurations are not feasible. Author

**N65-36037** Nuclear Metals, Inc., Concord, Mass.
**X-RAY FILM DEFECTS AND AUTORADIOGRAPHY OF FUEL ELEMENTS FOR CLADDING THICKNESS MEASUREMENTS**

H. P. Roth *In its* Tech. Papers of the 14th Metallographic Group Meeting 6 Jan. 1964 p 149–163 (See N65-36025 24-17) CFSTI: $5.00

Radiography of fuel element cladding can be performed by using the natural radioactivity of the core material as the source of exposure. X-ray film is placed in close contact with the surface of the cladding for several hours and the film is exposed by rays from the uranium which penetrate the cladding. The resulting density of the processed film at any specific location is related to the thickness of the cladding at the same location on the fuel element. By measuring photographic film density and comparing it with that of a standard film, which has been exposed and processed at the same time as the subject film, one can determine cladding thickness. The degree of accuracy depends upon carefulness in control of the entire autoradiographic procedure. Plus or minus 10 percent accuracy is normal for cladding below 20-mils in thickness. This method is not suitable for measuring more than 30-mils of Zircaloy or 50-mils of aluminum. Author

**N65-36121#** Argonne National Lab., Ill.
**REACTOR DEVELOPMENT PROGRAM Progress Report, Aug. 1965**
R. M. Adams and A. Glassner, Coord. 21 Sep. 1965 87 p refs
(Contract W-31-109-ENG-38)
(ANL-7090) CFSTI: $3.00

Work on liquid-metal cooled reactors was conducted. In the development of fast reactor fuels, six U-15 w/o Pu-10 w/o Fs samples in V-20 w/o tubing were irradiated to 5 a/o burnup before the first evidence of failure occurred. These capsules had been designed for 3.1 a/o burnup. Samples of the U–Pu–Ti and U–Pu–Zr alloys went successfully beyond 4 a/o burnup. In other work, the Experimental Breeder Reactor-II was operated to 45 MWt and about 1.1 a/o maximum burnup. The methods of fission product monitoring appear to be satisfactory; the anomalous swelling behavior of the special surveillance samples possibly being due to the poor quality of sodium bonds. The A-E Title II design for the FARET, is essentially complete; and FARET criticals were completed. Work is also reported for other advanced systems, and in nuclear safety. L.S.

**N65-36135#** Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.
**THORIUM-1.4 wt % $^{235}$URANIUM METAL FUEL TUBES—FABRICATION AND IRRADIATION IN HWCTR**
Stephen R. Nemeth, ed. Jul. 1965 31 p Prepared jointly with Nucl. Metals, Inc.
(Contract AT(07-2)-1)
(DP-943) CFSTI: $2.00

Three thorium-1.4 wt % $^{235}$uranium alloy fuel tubes with zircaloy-2 cladding were fabricated. Two of the tubes were irradiated in the heavy water components test reactor (HWCTR) to an exposure of 3500 MWD/Te without failure. This report describes the effort to develop a coextrusion process for fabrication of these tubes, and includes the results of the irradiation of the tubes in the HWCTR. Author

**N65-36137#** Argonne National Lab., Ill.
**CATALOG OF NUCLEAR REACTOR CONCEPTS. PART I: HOMOGENEOUS AND QUASI-HOMOGENEOUS REACTORS. SECTION I: PARTICULATE-FUELED REACTORS**
Charles E. Teeter, James A. Lecky, and John H. Martens May 1964 173 p refs
(Contract W-31-109-ENG-38)
(ANL-6892) CFSTI: $2.75

A catalog which cites the various concepts of reactors regardless of whether or not the concepts have realized is presented. The concept descriptions are organized in chapters according to their generic relationships. Each chapter contains a narrative description of the concepts, highlighting their main features, resemblances, and differences. References for obtaining engineering data are given. A coding classification system for selecting reactors by moderator, coolant, fuel, or any other coded characteristic is included. Most reactor concepts are divided into two main parts: homogeneous and heterogeneous. A few concepts fall into a third, miscellaneous, part. The first part is divided according to the fuel, and the second part is divided according to the coolant. Purposes of reactors are identified, but the reactors are cataloged according to their core characteristics. Cataloged here are: particulate-fueled reactors and reactors fueled with homogeneous aqueous solutions and slurries, homogeneous molten salts, liquid metals, and uranium hexafluoride. C.T.C.

**N65-36139#** Atomics International, Canoga Park, Calif.
**COOLANT DECOMPOSITION RATES AND MAKEUP COSTS FOR ORGANIC REACTORS**
R. H. J. Gercke and J. F. Zack, Jr. 15 Jun. 1964 42 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-6920) CFSTI: $1.00

This report summarizes the results of several recent experimental programs conducted to evaluate the effect of fission neutrons on terphenyl coolant and establish differences between decomposition rates due to fast neutrons and gamma rays. Interpretation of these results indicates that, at 600° F, fast neutrons are approximately 4.4 ±0.5 times more damaging than gamma rays for the same amount of radiation energy deposited. It is also indicated that the "fast neutron effect" increases with temperature. New techniques for calculation of radiation energy absorption in organic reactors have been applied to three large Organic Moderated and Cooled central station power plant designs as well as to the OMRE and PNPF (Piqua). Coolant makeup rates and costs are calculated. Based on a coolant cost of $0.17/lb, the overall coolant makeup costs for these power reactors are 0.56 to 0.83 mill/kwhe, depending on the particular reactor design. Author

**N65-36140#** Atomics International, Canoga Park, Calif.
**STEAM CYCLE OPTIMIZATION STUDY FOR LARGE SODIUM GRAPHITE NUCLEAR POWER GENERATING STATIONS**
G. A. Schneider 31 Aug. 1964 88 p refs
(NAA-SR-9488) CFSTI: $2.00

This report presents steam cycle optimization studies for large sodium graphite nuclear power generating stations. The general trend that is apparent from the optimization studies for SGR nuclear power plants are as follows: For plant ratings up to approximately 350 Mwe, 2400-psig steam pressure would be the most economical operating condition. For plant ratings above 350 Mwe, 3500-psig steam pressure is the economic selection. The highest justifiable steam temperature for reheat cycles at 1150° F reactor outlet temperature is 1000/1000° F, the final selection being either 950/950° F or 1000/1000° F. For all plant ratings studied, the best range for the value of the sodium temperature difference across the reactor is from 350 to 375° F. The best range for the value of the temperature approach of the intermediate heat exchanger for the 2400-psig steam cycle is 65 to 80° F; while for the 3500-psig steam cycle, the range is 85 to 95° F. Decisions on the actual plant design steam conditions should be based on studies for a specific plant site and on specific utility company ground rules, not on generalized steam studies. Author

**N65-36141#** Argonne National Lab., Ill.
**A TWP-ZONE FAST CRITICAL EXPERIMENT (ZPR-III ASSEMBLY 42)**
P. I. Amundson, R. L. Mc Vean, and J. K. Long Jan. 1964 36 p refs
(Contract W-31-109-ENG-38)
(ANL-6733) CFSTI: $0.75

This study was conducted to determine what properties of a previously studied dilute power reactor could be duplicated in a smaller two-zone assembly. Reactivity measurements performed included determinations of plate-orientation worth, homogeneity corrections, reactor-segment worths, central reactivity coefficients, and radial worth distributions of axial columns of core materials. Spectral index determinations included: central fission ratios, nuclear track emulsion measurements, fission counter traverses, Rossi-alpha measurements, sodium activation, and natural and enriched uranium foil measurements.
Author

**N65-36147#** Atomics International, Canoga Park, Calif.
**NUCLEAR STARTUP EXPERIMENTS FOR HNPF**
M. P. Aronchick 15 Oct. 1964 27 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10078) CFSTI: $0.50

The important results of the nuclear startup experiments at the Hallam Nuclear Power Facility (HNPF) are presented and then compared with the theoretical predictions as follows: (1) The dry critical loading was 30.6 elements, compared with an initial prediction of 23 and an updated prediction of 32. The corresponding wet critical values were 52, 37, and 50, respectively. (2) The experimentally determined excess reactivity for 140 elements at an isothermal temperature of 350° F was 7.5% $\Delta k/k$, compared with a predicted 6.9% $\Delta k/k$. (3) The experimental sodium worth was 4.1% $\Delta k/k$, compared with predictions of 4.8% $\Delta k/k$. (4) Total rod work was measured as 12.5% $\Delta k/k$, compared with predictions of 12.7% $\Delta k/k$. Other quantities compared and discussed are power coefficients and xenon worth.
Author

**N65-36148#** Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
**PRTR CONTAINMENT VESSEL PRESSURE TEST EXPERIENCE**
R. G. Clark and D. R. Koberg Aug. 1965 72 p refs
(Contract AT(45-1)-1830)
(BNWL-109) CFSTI: $3.00

A leakage rate of slightly less than 0.9% per 24 hr at the design pressure of 15 psig was determined for the containment vessel at the Plutonium Recycle Test Reactor (PRTR). The results were obtained in a series of tests using the reference volume method in which 475 ft of 3/4 inch thin-walled copper tubing constituted the reference volume. Results conducted at 3, 6, and 15 psig showed that the leakage rates varied approximately as the square roots of the ratios of the gauge pressures. The test installation and the method of testing at PRTR were verified by superimposing a 0.9% leakage rate on the vessel having a leakage rate of 1.3%. The superimposed leakage rate was measured by a rotameter. The measured leakage rate increased from 1.3 to 2.1%, giving an increase of 0.8%.
E.E.B.

**N65-36209#** Argonne National Lab., Ill.
**REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, MARCH 1964**
R. M. Adams and A. Glassner 15 Apr. 1964 88 p refs
(Contract W-31-109-ENG-38)
(ANL-6880) CFSTI: $2.00

Progress is reported on Borax V reactor; liquid-metal-cooled reactors, reactor technology, advanced systems, and nuclear safety. Also, a brief bibliography of publications is included. General fast reactor physics, reactor fuel and fuel processing development, EBR-II and Faret reactors are discussed. Under the subject of reactor technology, experimental reactor and nuclear physics, theoretical reactor physics, high-temperature materials development, remote control engineering, heat engineering, and chemical separations are considered. The advanced systems include the Argonne Advanced Research Reactor (AARR), magnetohydrodynamics, and regenerative EMF cells.
E.E.B.

**N65-36215#** Atomics International, Canoga Park, Calif.
**DEVELOPMENT, ACCEPTANCE AND QUALIFICATION TESTING OF THE SNAP 10A EJECTABLE HEAT SHIELD**
H. L. Sperow 31 Aug. 1965 72 p ref
(Contract AT(11-1)-GEN-8)
(NAA-SR-10997) CFSTI: $3.00

The development, acceptance, and qualification tests performed on the SNAP 10A ejectable heat shield and components, the results of those tests, and the conclusions drawn from the results are presented in this report. The final conclusions made of the completion of the qualification program were as follows: (1) The heat shield will maintain the heat exchange fluid within the prescribed limits of 50 to 250° F, thus preventing plugging of the NaK lines during the orbital period before startup of the nuclear reactor. (2) The heat shield will perform satisfactorily provided the outside shield temperatures do not exceed 375° F. The shield will eject from the nuclear power unit when the temperature of the heat exchange fluid at the reactor outlet approaches 275 ±25° F, and will clear all vehicle components.
Author

**N65-36222#** Argonne National Lab., Ill.
**THE RATIO OF $U^{238}$ CAPTURE AND $U^{235}$ FISSION CROSS SECTIONS IN FAST REACTORS**
William G. Devey May 1965 33 p refs
(Contract W-31-109-ENG-38)
(ANL-7034) CFSTI: $2.00

A new activation technique has been developed for the measurement of the ratio of the capture cross section of $U^{238}$ and the fission cross section of $U^{235}$ in zero-energy fast reactors. The new technique is a direct counting method which does not involve chemical separation in any way. Measurements have been made in four ZPR-3 fast reactor assemblies, two with hard spectra and two with soft spectra. In all four cases the measured ratio was slightly (4%) higher, on the average, than the calculated value. This is in strong contrast with the past radiochemical measurements in ZPR-3 assemblies, which gave values 16% less than calculation. The present measurements, therefore, support the general correctness of the calculated ratio, and hence indicate that there are no gross errors in the assumed average microscopic values of the $U^{238}$ capture cross section and the $U^{235}$ fission cross section.
Author

**N65-36261#** Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
**FUSION REACTOR BLANKET EXPERIMENT Fourth Technical Report**
Patrick S. Spangler (Ph.D. Thesis) 13 Jul. 1965 179 p refs
Sponsored in part by AEC
(Contract DA-36-039-AMC-03200(E); Grant NSF GK-57)
(TR-437; AD-619671)

The behavior of 1–14 Mev neutrons has been measured in cylinders, 46 cm in diameter and 38 cm thick, to evaluate previous theoretical calculations on neutron economy and tritium

production in proposed fusion reactor blankets. The cylinders were constructed from 0.5-inch graphite slabs and 1-inch layers of solid lithium–beryllium fluoride salt encased in aluminum pans. To approximate first-wall materials, 0–3 cm molybdenum plates were placed at the base of the cylinder. A point source of 14-Mev neutrons on the center line of the cylinder, 14 cm below its base, was produced by bombarding an adsorbed tritium target with the deuteron beam from a 150-kev Cockcroft–Walton accelerator. The design and operation of a tritium gas target for a 1–3 Mev Van de Graaff accelerator is also described. The neutron spectrum $\phi(E)$ was measured with a series of threshold detectors: U-238(n,f), P-31(n,p), Fe-56(n,p), I-127(n, 2n), and F-19(n,2n). The spectrum is determined from the threshold detector data by the method of W. D. Lanning and K. W. Brown, in which $\phi(E)$ is expanded as the product of a weight function w(E) and a weighted sum of polynomials which are orthogonal with respect to w(E). Author

**N65-36262#** Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
**GAMMA-RAY SPECTRA IN FUSION BLANKET MOCK-UPS Fifth Technical Report**
Lester M. Petrie, Jr. (Ph.D. Thesis) 20 Jul. 1965 111 p refs
(Contract DA-36-039-AMC-03200(E); Grant NSF GK-57)
(TR-438; AD-619672)

Gamma ray spectra have been measured in cylinders, 18 inches in diameter and 15–16 inches thick, to evaluate previous theoretical calculations of gamma ray spectra in proposed fusion reactor blankets. The cylinders were constructed of 0.5 inch graphite slabs and 1-inch thick layers of lithium–beryllium fluoride salt mixture contained in aluminum pans. Molybdenum plates were used to approximate first walls, 0–1.25 inches thick. The cylinders were irradiated by 14-Mev neutrons produced by bombarding a tritium target with a beam of deuterons from a 150-kilovolt Cockroft–Walton accelerator. The target was positioned on the center line of the cylinder, 5.25 inches from its base. The gamma ray spectra were measured by collimating a beam of gamma rays leaking out of the side of the blanket mock-up and by using a sodium iodide scintillation crystal as a detector. The gamma ray spectra from the graphite assemblies are characterized by a large peak at 4.43 Mev, a smaller peak at 6.87 Mev, and a still smaller peak at 4.95 Mev. The spectra in the salt assemblies are characterized by large peaks at 6.63 Mev and 5.13 Mev, and several smaller peaks. The relative magnitudes of these peaks at different depths in the assemblies are in agreement with previous theoretical calculations. Author

**N65-36466#** Los Alamos Scientific Lab., N. Mex.
**ULTRA HIGH TEMPERATURE REACTOR EXPERIMENT (UHTREX) Quarterly Status Report, Period Ending 20 Jun. 1964**
22 Jul. 1964 23 p
(Contract W-7405-ENG-36)
(LA(MS)-3112) CFSTI: $0.50

Continued research conducted under the Ultra High Temperature Reactor Experiment (UHTREX) is reported. Presented are data on inherent problems associated with unsatisfactory leakage rates which inhibited completion of the UHTREX facility construction; a computer program used to produce wiring lists for UHTREX circuits; reactor components (design, fabrication, and testing); the helium cooling system; systems analyses; neutronic calculations; and graphite corrosion. S.C.W.

**N65-36473#** Joint Publications Research Service, Washington, D. C.
**EQUALIZATION OF NEUTRON FLUX IN NUCLEAR REACTORS**
13 Oct. 1965 9 p Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 19, no. 1, Jul. 1965 p 36–38
(JPRS-32368; TT-65-32858) CFSTI: $1.00

Critical experiments are described in which thermal neutron flux in heterogeneous nuclear reactors is formed by shaping the fuel charge. The critical loads of the shaped systems, the radial distributions of the thermal and epicadmium neutron fluxes, the relative value of the fuel, and the relative effect of the cadmium absorber on the reactivity of the assembly were determined. Other critical experiments are also described in which equalization of energy release over the volume of the active zone of nuclear power reactors is accomplished by aligning the fuel elements (with a fixed fuel content) in the form of a checkerboard. Data for both sets of critical experiments are graphically presented. In addition, the results of an analysis of variants for calculations of uranium-and-water thermal reactors with equalized thermal neutron flux are given. L.S.

**N65-36484#** Argonne National Lab., Ill.
**A SUMMARY OF THE OPERATION OF THE ANL-2 PRESSURIZED WATER LOOP AT THE MTR Final Report**
C. C. Crothers May 1964 32 p refs
(Contract W-31-109-ENG-38)
(ANL-6821) CFSTI: $0.75

This report is a summary of the operation of the ANL-2 pressurized water loop at the MTR. Special attention has been given to operational problems and to the modifications which were made to eliminate these problems. Twelve successful experimental tests were completed. Each test is described briefly. The operation of the loop was essentially continuous during the entire testing period. Author

**N65-36485#** Atomics International, Canoga Park, Ill.
**HNPF MODERATOR ELEMENT DEVELOPMENT Final Report**
L. Newcomb 15 Jun. 1964 55 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-6508)

The design of the moderator elements for the Hallam Nuclear Power Facility was established by testing full size prototypes under simulated operating, but non-radioactive, conditions. The test elements were subjected to a series of environmental, material, and friction tests. Analysis of the test results verified the design feasibility as well as prompting investigation of fabrication techniques. Test methods, results and analysis thereof are presented in detail in this final report covering moderator element development. Author

**N65-36487#** Atomics International, Canoga Park, Calif.
**UC FUEL ELEMENT DESIGN AND FABRICATION**
W. Draganchuk 1 Aug. 1964 83 p
(Contract AT(11-1)-GEN-8)
(NAA-SR-9988) CFSTI: $2.00

Uranium monocarbide shows considerable potential for use as a fuel in high temperature, high power density, nuclear powar reactors. In proposing its use in sodium graphite type reactors, it was necessary to develop a process for fabricating sodium bonded uranium carbide fuel elements. It was further necessary to demonstrate the feasibility of the process by fabricating full scale sodium bonded fuel elements for installation in a nuclear reactor core. Following preliminary design and development efforts, ten sodium bonded uranium carbide hypostoichiometric fuel elements were fabricated for installation in the Hallam Nuclear Power Facility. The development and fabrication of sodium bonded, stainless steel clad UC fuel elements was the first accomplishment of this type reported. Processing of melt

stock, fuel rod fabrication and testing, including a process for reclaiming fuel from rejected fuel rods without having to remelt, are discussed in detail in this report. Author

**N65-36489#** Argonne National Lab., Ill.
**PHYSICS PERFORMANCE OF THE EBWR IN ITS OPERATION FROM ZERO TO 100 MWt**
A. P. Iskenderian May 1965 28 p refs
(Contract W-31-109-ENG-38)
(ANL-6776) CFSTI: $2.00

A physics analysis was made of a core to determine the static characteristics and to check calculations with experimental data. A cold calibration of the bank of nine rods was obtained from a series of period runs in terms of the reactivity worths of $H_3BO_3$. Measurements were made to determine the void coefficients in the EBWR for varying concentrations of $H_3BO_3$ at room temperature. The reactivity effects of void simulators in a region were measured with the aid of a single rod located furthest from this region, to minimize the effect of the simulator voids on the calibration of the rod. These measurements were made in two regions for two concentrations of $H_3BO_3$, i.e., 0.4 and 3.37 g of $H_3BO_3$ per gallon of water. The results of these measurements were assembled, and the simulator locations were shown. R.W.H.

**N65-36499#** Oak Ridge National Lab., Tenn. Metals and Ceramics Div.
**IRRADIATION BEHAVIOR OF HIGH BURNUP $ThO_2$-4.54% $UO_2$ FUEL RODS**
S. A. Rabin, J. M. Ullmann, E. L. Long, Jr., M. F. Osborne, and A. E. Goldman Oct. 1965 78 p
(Contract W-7405-ENG-26)
(ORNL-3837) CFSTI: $3.00

A series of fuel rods, $ThO_2$-4.45% $UO_2$ pellets clad with type 304 stainless steel, has been successfully irradiated in MTR or ETR process water. The fuel rods achieved burnups that ranged from 37 000 to 96 000 Mwd/MT(U+Th) at linear heat ratings up to 48 000 Btu/hr-ft. Three fuel rods were selected from this series of irradiation tests and given a thorough post-irradiation examination. The results of this examination showed that no appreciable swelling occurred in any of the fuel rods examined. The fission-gas release was 14% for the rod that experienced the highest burnup, which indicates that fission-gas retention in the $ThO_2$–$UO_2$ system is comparable to other fueled-oxide systems irradiated under similar conditions. No major changes were observed in the microstructural details of the fuel pellets or the cladding after irradiation. Analysis of the fuel by X-ray diffraction showed evidence of lattice strain and that a relatively crystalline structure was maintained. This series of experiments is additional evidence of the stability of $ThO_2$–$UO_2$ fuels when irradiated to high burnups. Author

**N65-36501#** Martin Co., Baltimore, Md. Nuclear Div.
**DYNAMICS AND LOADS ANALYSIS OF SUPPORT STRUCTURE FOR SNAP-19 GENERATORS (NIMBUS APPLICATION)**
B. T. Bata and R. S. Buxbaum Aug. 1964 25 p
(Contract AT(30-1)-3169)
(MND-3169-18)

A three-dimensional structural dynamics analysis was carried out to evaluate the design of the generator support structure. The various configurations analyzed are described. Results (frequencies, internal loads, deflections, and reactions at satellite interface) are given in detail for the final configuration. NSA

**N65-36502#** Martin Co., Baltimore, Md. Nuclear Div.
**SNAP 19 PROGRAM: GENERATOR SUPPORT STRUCTURE TRANSMISSIBILITY TEST REPORT**
G. N. Numsen Apr. 1965 62 p refs
(Contract AT(30-1)-3169)
(MND-3169-61)

This report describes and presents the results of transmissibility tests conducted on the generator and support structure assembly of the SNAP 19 Radioisotope Thermoelectric Generator power supply system for the Nimbus B Satellite application. Transmissibility data is presented in the form of response vs. frequency plots for various locations and vibration conditions. Author

**N65-36505#** Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
**DISPERSAL OF REACTOR CORE MATERIALS BY REENTRY PROCESSES Quarterly Report, Nov. 1, 1964–Jan. 31, 1965**
J. L. Beal, W. R. Brown, and F. A. Vassallo Jan. 1965 27 p refs Prepared for Sandia Corp.
(CAL-114-020-1; TID-21723)

Information about the rate of $O_2$ absorption by metallic Zr as it is heated from 500 to 3830° R is presented. This was accomplished by stopping the heating at various temperatures, cooling rapidly in an inert atmosphere, and determining the increase in weight due to $O_2$ absorption. The temperature rise of specimens was determined as a function of time and compared with that for otherwise identical specimens which were coated to prevent oxidation. Oxidation heating rates were computed from these data. Specimens were sectioned and examined microscopically. Test conditions were selected so that the diffusion-controlled rate of oxidation (the case in which all of the $O_2$ in the air which diffuses to the solid surface reacts) is comparable to that in free-flight conditions associated with reentry. The time of heating of the specimen from low to high temperature was an arbitrary variable. Specimens were heated from 500° R to high temperature in 3 to 15 seconds. The data resulting from this type of testing were scattered. NSA

**N65-36507#** General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
**MONEY—A REACTIVITY DATA REDUCTION PROGRAM FOR THE IBM 1620 COMPUTER**
R. A. Reiter 11 Jan. 1965 8 p
(Contract W-31-109-ENG-52)
(KAPL-M-6408)

A program for the IBM-1620 computer was written to analyze counter-type reactivity data. A weighted least squares method is used to reduce the data. The output includes the doubling time, the reactivity in cents, the growth constant, and the reactor multiplication constant. Author

**N65-36508#** General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
**TIM-3: A FLUX WIRE DATA REDUCTION PROGRAM FOR REACTOR PROTOTYPE EVALUATION**
Sally A. Gazda 15 Feb. 1965 22 p refs
(Contract W-31-109-ENG-52)
(KAPL-M-6445; EC-48)

The TIM-3 program reduces flux wire activation data to a form useful for engineering and physics analyses. Standard reactor physics calculational methods are used in obtaining the decay corrected counts, depletion, and power distribution along the wires from uncorrected flux wire data. The data reduction involves the use of a series of averaging procedures

and will automatically compensate for activation changes caused by spatial and time variations. TIM-3 processes up to 22 wires with 50 counting intervals per wire. The approximate running time is four minutes per case. Author

N65-36529# General Dynamics Corp., San Diego, Calif. General Atomic Div.
**ADVANCED HTGR FUEL ELEMENT VIBRATION TESTS**
R. J. Kiefer and T. R. Sparks 29 Dec. 1964 21 p refs
(Contract AT(04-3)-167)
(GAMD-6145)

Resonant frequencies and their amplitudes were measured on the large HTGR fuel element. A variety of methods were used to induce vibrations. Results were compared to calculated values of the natural frequencies and the amplitudes were compared to mathematical expressions derived by other investigators for flow induced vibrations. Author

N65-36555*# Princeton Univ., N. J. Dept. of Aeronautical Engineering.
**CONCEPTUAL DESIGN STUDY OF A LIQUID-CORE NUCLEAR ROCKET Technical Report No. 665**
Seymour T. Nelson Sep. 1963 102 p refs
(Grant NsG-389)
(NASA-CR-67555) CFSTI: HC $4.00/MF $0.75 CSCL 21 F

A liquid-core nuclear rocket conceptual design study was conducted based on realistic assumptions regarding nucleonics, bubble flow, heat transfer, and fuel-mixture vapor loss. The reactor is a matrix of mechanically driven rotating hollow cylinders composed of a fissionable fuel mixture and cooled by a radially inward flow of hydrogen. It operates with the cylinder inner surface in the molten state. Parameter optimization calculations demonstrated that the vacuum specific impulse of the system is limited by fuel-mixture vapor loss to 1200 seconds at engine thrust/weight ratios over the range 0.05 to 0.5, with chamber pressures in the range 3 to 100 atm, peak molten surface temperatures of 3600° to 3800° K, and $ZrC/UC_2$ dilution ratios between 250 and 1500. Thrust levels are limited by bubble flow area. Fuel element diameters may be in the order of an inch and rotation speeds in the order of 5000 rpm. Although the maximum attainable specific impulse of the liquid core nuclear rocket is lower than expected, it appears theoretically feasible and performance levels are high enough to warrant more detailed studies. R.N.A.

N65-36566# Argonne National Lab., Ill.
**PROCEEDINGS OF THE CONFERENCE ON THE APPLICATION OF COMPUTING METHODS TO REACTOR PROBLEMS**
Aug. 1965 573 p refs Conf. held 17–19 May 1965
(Contract W-31-109-ENG-38)
(ANL-7050) CFSTI: $6.00

CONTENTS:

1. NUMERICAL ANALYSIS AND REACTOR MATHEMATICS p 13–213 refs
2. LINKED CALCULATIONS p 215–324 refs
3. KINETICS STUDIES p 325–441 refs
4. SPECIAL METHODS p 443–514 refs
5. MONTE CARLO COMPUTATIONS p 515–600 refs

N65-36569# Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Electromechanical Div.
**SNAP 2 POWER CONVERSION SYSTEM. MERCURY MATERIALS EVALUATION AND SELECTION GFY-1963 Topical Report No. 24**
James F. Nejedlik 30 Mar. 1964 150 p refs Prepared for Atomics Intern.
(Contract AT(11-1)-GEN-8)
(TRW-ER-5643; NAA-SR-6316) Available from AEC, Oak Ridge, Tenn.: $3.45 (Declassified)

SNAP 2 is the designation for a 3 kilowatt nuclear auxiliary power unit to be used in a satellite vehicle. It is a Rankine power system consisting of a reactor heat source, a boiler, a condenser, a mercury turbine, and an alternator. Corrosion of the system by the working fluid, mercury, results in two undesirable effects: (1) wall penetration and (2) mass transport of corrosion products. Judicious choice of materials can only be made with a knowledge of corrosion behavior. Furthermore, to make use of conventional materials of construction corrosion product removal is desirable to reduce fouling tendencies of the power system. Consequently, corrosion, mass transfer, and corrosion product removal were investigated and the results are presented. This report covers the materials investigation for the Fiscal Year 1963. Author

N65-36599# General Dynamics/Astronautics, San Diego, Calif.
**STUDY OF THERMAL DEGRADATION AND COMPLETION OF RE-ENTRY MODEL FOR NUCLEAR AUXILIARY POWER (NAP) SYSTEMS First Quarterly Report, 1 Jul.–30 Sep. 1964**
30 Sep. 1964 19 p refs
(Contract AF 29(601)-6437)
(GDA-DBE64-058; AD-463715)

The inward diffusion of heat and the outward diffusion of hydrogen within reentering fuel rods were analyzed by the computer program developed under the previous project. The temperature and gas concentration distributions within the rod, except near the ends, depend upon the radial coordinate at any instant of time. The analogy between heat and mass diffusion was used together with an assumed linear coefficient of sorption expansion to obtain a straightforward extension of the results for thermal stress. The stress equations are discussed, and the experimental program is described. E.E.B.

N65-36633# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
**MEASUREMENTS IN THE WATER-GRAPHITE ZERO POWER ANNA REACTOR USING THE PULSE NEUTRON SOURCE [OPREDELENIE PARAMETRA $\beta/\Lambda$ GRAFITO-VODYANOGO REAKTORA NULEVOY MOSHCHNOSTI "ANNA" PRI POMOSHCHI IMPUL'SNOGO ISTOCHNIKA NEYTRONOV]**
S. Khvashchevski and K. Dybovski Mar. 1965 21 p refs In RUSSIAN; ENGLISH summary Presented at the Intern. Atomic Energy Conf., Karlsruhe, West Germany, 1965
(Rept.-614/IXA/P) CFSTI: HC $1.00/MF $0.50

Criticality and reactivity of the control and safety rods of the ANNA reactor were measured utilizing pulse neutron sources. Because the prompt and delayed neutron life times in the ANNA reactor are comparable, corrections had to be introduced into the relations for criticality and reactivity with the prompt neutron decay constant. The method of the results of processing are also given. Author

N65-36695# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Institut für Chemie.
**THE PRODUCTION OF SPHERICAL NUCLEAR FUEL PARTICLES FROM SOLUTIONS AND SOLUTION-SUSPENSIONS [DIE HERSTELLUNG SPHARISCHER KERNBRENNSTOFFTEILCHEN AUS SCHMELZEN UND SCHMELZSUSPENSIONEN]**

K. Knotik, H. Bildstein, P. Koss, G. Stolba, and H. Märkl [1964] 19p refs In GERMAN Submitted for Publication
(SGAE-CH-14/1964) CFSTI: HC $1.00/MF $0.50

The production of uranium carbide spheres as well as of uranium–thorium carbide fuel particles for high-temperature gas-cooled reactors was discussed. One method used a small orifice to spray the melted metal–carbon mixtures, suspended in paraffin, into a cold bath; the other procedure consists of dropping acid melt mixture into a cooling oil bath where the spheres harden, are subsequently extracted, and sintered to obtained oxidation. Transl. by G.G.

**N65-36779*#** General Electric Co., Pleasanton, Calif. Special Purpose Nuclear Systems Operation.
**RESEARCH PROGRAM FOR THE LONG TERM TESTING OF CYLINDRICAL DIODES AND THE IRRADIATION OF FUEL AND INSULATOR Seventh Quarterly Progress Report, Dec. 18, 1964–Mar. 17, 1965**
18 Apr. 1965 78 p refs
(Contract NAS3-2544)
(NASA-CR-54656; GEST-2049) CFSTI: HC $3.00/MF $0.75 CSCL 18E

Progress on the research program for the long term testing of cylindrical diodes and the irradiation of fuel and insulator is reported. The program consists of the following work phases: (1) development of basic converter life, (2) thermal and irradiation testing of fuel/clad emitter, and (3) irradiation of high purity alumina at temperature. Out-of-pile converters 311, 312, and 313, were operated for 6413, 5807, and 3775 hrs, respectively. Converter 311 failed at 6413 hrs by indicating cesium leakage into the bombardment chamber. Converter 313 failed similarly after having been thermal cycled 6 times. Converter 312 is continuing in test. The stress analysis and design of the TFE were completed, and the out-of-pile converter design was initiated. Extensive fabrication of the W-25% Re fueled converter is reported. Long term high temperature compatibility tests of $UO_2$ clad with W-25% Re were continued. Fuel clad irradiation experiments were redesigned to attain a burnup in the $UO_2$ fuel of $1 \times 10^{20}$ fissions/cm$^3$ with a minimum irradiation time, using as many of the fabricated capsule components as possible. Research related to phase-3 of the program consisted of analyses designed to more accurately define previously reported data on the fast flux history of capsule irradiations. S.C.W.

# 23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

**N65-35781*#** National Aeronautics and Space Administration, Washington, D. C.
**SCATTERING OF SOUND IN TURBULENT FLOW [UBER DIE SCHALLSTREUUNG IN DER TURBULENTEN STROMUNG]**
A. M. Obukhov Jul. 1965 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 30, no. 7, 1941 p 616–620
(NASA-TT-F-9493) CFSTI: HC $1.00/MF $0.50 CSCL 20A

An attempt is made to establish an equation for the scattering of sound within the turbulent atmosphere under the following assumptions: the distribution of the turbulent pulsations in space is random, statistically stationary and isotropic in the sense of Karmann. Expressions are derived for the amount of acoustic energy scattered into an elementary solid angle in a certain direction and per unit of time, as well as for the total scattered energy. Author

**N65-35790*#** Consultants and Designers, Inc., Arlington, Va.
**ON THE GENERALIZATION OF RICE FORMULAS AND THEIR APPLICATION FOR THE DETERMINATION OF SPECTRAL DENSITIES [SUR UNE GENERALISATION DES FORMULES DE RICE ET LEUR APPLICATION A LA DETERMINATION DES DENSITES SPECTRALES]**
Gabriel Coupry 11 Oct. 1965 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci., Mecan. de l'Atmosphere (Paris), v. 260, 3 May 1965 p 4801–4803
(Contract NAS5-3760)
(NASA-TT-F-9907; ST-AM-10397) CFSTI: HC $1.00/MF $0.50 CSCL 20

A rapid and precise method of obtaining spectral densities is presented. The formulas proposed by Rice for the gaussian stationary processes are extended to stationary processes of any distribution functions. These formulas, which determine the mean number of zeros per second of an uncertain function of t, are the basis for the presented method. The derivation is shown in detail, and the advantages of the new method are pointed out. C.T.C.

**N65-35830*#** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
**ABSORPTION TABLES FOR ELECTRON PROBE MICROANALYSIS**
I. Adler and J. Goldstein Washington, NASA, Oct. 1965 275 p refs
(NASA-TN-D-2984) CFSTI: HC $6.00/MF $1.50 CSCL 20

The values of the absorption correction f(x) are a function of the element from which the K, L, or M spectra is produced; the atomic number of the absorber, $\bar{Z}$; the operating voltage, $V_o$; the overvoltage $V_o/V_c$; and x, the absorption parameter. Three sets of tables have been prepared which, when used together, take into account these variables. These tables are calculated from the Philibert absorption correction and the Duncumb and Shields overvoltage correction. The agreement found between the tabulated values and experimental data shows that the tables can be used with confidence for all the elements and for a range of operating potentials from 5 to 35 kv. A section on how to use the tables is also included. Author

**N65-35836*#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
**AN APPROXIMATE SOLUTION FOR LUMINOSITY DISTANCE IN ZERO-PRESSURE RELATIVISTIC MODEL UNIVERSES THAT HAVE THE U-PROPERTY**
Windsor L. Sherman Washington, NASA, Oct. 1965 14 p refs
(NASA-TN-D-3047) CFSTI: HC $1.00/MF $0.50 CSCL 03B

Finite-density zero-pressure models of the universe based on general relativity are studied. These models have the U-property (time-dependent uniformity) and a metric subspace described by the Robertson-Walker metric. Highly accurate approximate closed-form expressions for the radial metric variable, the luminosity distance, the time of light travel, and the scale factor of the universe are obtained. The results are used to obtain new forms of the redshift-magnitude and count-magnitude relations that are useful for the analysis of observational data once the signs of the cosmical constant

and curvature constant are known. The redshift-magnitude relation is of a form that permits the determination of the density parameter from apparent magnitude and redshift data. Author

**N65-35850#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**JOURNAL OF APPLIED MECHANICS AND TECHNICAL PHYSICS, NO. 1, 1964 Collection of Articles**
4 Mar. 1965 235 p refs Transl. into ENGLISH of Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 1, Jan.–Feb. 1964 p 1–137
(FTD-MT-64-284; AD-61521)

Studies concerning ion beams, thermal flow, gas flow and boundary layer problems, entropy layers, shock waves, and properties of plasmas are reported. For individual titles see N65-35851–N65-35875.

**N65-35904#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EFFECT OF THE INERTIA OF CARDAN SUSPENSION DISKS ON THE MOTION ON A GYROSCOPIC INTEGRATION OF LINEAR ACCELERATIONS**
L.N. Slezkin 7 Jul. 1965 10 p refs Transl. into ENGLISH from Mekhan. i Mashinostr. (USSR), no. 4, 1964 p 145–147
(FTD-TT-65-333/1+2+4; AD-618059)

The inertia effect of cardan suspension disks on the motion of linear accelerations in a heavy gyroscope is considered. An analogical phenomenon occurs, and is revealed in the fact that the speed of turning of the outer disk differs from the angular velocity equation, $da/dt = mg1/H$, leading to an error in the gyrointegrator. Starting from the equations of motion for the instrument, an equation which gives the relative error is derived. C.T.C.

**N65-35925#** Army Missile Command, Huntsville, Ala. Physical Sciences Lab.
**CLASSICAL FIELDS OF GRAVITATION**
Vitalij Garber and C. A. Coulter, ed. 10 May 1965 37 p refs
(RR-TR-65-5; AD-467414)

Lagrangian formalism in four-dimensional space-time is discussed. Euler-Lagrange motion equations are obtained using Hamilton's principle. Criteria for Lorentz covariance are developed. Treatment of interacting fields using Lagrangian formulation is illustrated by considering charged particles in an electromagnetic field. Noether's theorem and its connection with conservation laws are outlined. The application to the particular case of orthoohronous Lorentz transformations is described. Gravitational experiments supporting the general theory of relativity are reviewed. Concepts of gravitational and inertial mass equivalence, general covariance, the metric tensor, Riemannian space, and covariant differentiation are developed. The Bianchi identities are derived from symmetry properties of the affine connection in the Riemannian metric space. Gravitational field equations for gravitational fields only and in the presence of other fields are derived. The necessity for explicitly introducing an interaction term in conventional and quantum mechanical theory is contrasted with the automatic implicit interaction found in the gravitational field theory. Exact solutions are obtained for the spherically symmetric Schwarzschild case. The approximate theory for the weak field case is discussed. R.N.A.

**N65-36021** Naval Ordnance Lab., White Oak, Md.
**MACHINE CLASSIFICATION OF ACOUSTIC SIGNALS**
C.N. Pryor *In* ONR Automation and the Navy [1964] p 116–126 (See N65-36014 24-08) CFSTI: $3.00

An experiment is described in automatic machine classification of aircraft according to their acoustic signatures. The aircraft are classified as being either piston, pure jet, or turboprop, according to the noise they generate during and after their takeoff run. An autocorrelation function is derived and used as the input to the linear classification system. The experimental procedure is described in detail, and the results are tabulated. C.T.C.

**N65-36118** Joint Publications Research Service, Washington, D. C.
**ACOUSTICS**
Ta-yu Ma *In its* Transl. on Communist China's Sci. and Technol., No. 213 2 Sep. 1965 p 38–43 Transl. into ENGLISH from Kuang-ming Jih-pao (Peking), 7 Aug. 1965 p 2 (See N65-36115 24-34) CFSTI: $2.00

The importance of acoustic research in the Chinese Peoples Republic is emphasized. In the field of national defense, the use of acoustics in anti-submarine warfare, navigational safety, jet aircraft design, missile and spacecraft design, aircraft detection, nuclear explosive surveillance, and communications is mentioned. Research in vibration and noise control, supersonics, electro-acoustics, and speech acoustics is discussed. Acoustics research began in the Chinese Peoples Republic in 1958. E.E.B.

**N65-36158#** Naval Ordnance Test Station, China Lake, Calif.
**INFRARED TRANSMITTANCE OF OPTICAL MATERIALS AT LOW TEMPERATURES**
George F. Linsteadt Jun. 1965 13 p refs
(NAVWEPS-8767; NOTS-TP-3849; AD-618744)

Transmittance measurements were made of a variety of infrared optical materials at approximate temperatures of 50°, 85°, and 300° K in the 1.0 to 15.0 micron wavelength region. Low temperature effects on transmittance are presented in the form of curves with transmittance as a function of wavelength. A change in external transmittance was measured for some materials. Low temperatures increase the infrared transmittance of the materials. An increase in transmittance at absorption edges is noticed in some materials. Whether this increase is due to a change in absorption coefficient or index of refraction has not been determined. An increase in transmittance and a shift in the absorption edge of the semiconducting crystals was observed which was within experimental error limits of the value predicted from the temperature dependence of the band-gap energy. R.N.A.

**N65-36213#** Long-Temco-Vought, Inc., Dallas, Tex. Astronautics Div.
**SINTERED CERAMIC COATINGS FOR THERMAL CONTROL**
R. L. Cox 14 Jan. 1964 23 p refs Presented at the 3d Am. Electroplater's Soc. Aerospace Finishing Symp., Dallas, 16–17 Jan. 1964
(Rept.-00.369)

By direct sintering of ceramic pigment particles, the need for an organic or inorganic binding matrix is eliminated in thermal control coatings. By eliminating the matrix, an improved potential for both optical performance and environmental stability is obtained. Results of preliminary research show that it is feasible to produce such a coating with a low solar absorptance and high total emittance. Measurements on initial trial specimens show a solar absorptance of 0.17 and a total emittance of 0.92. A good quantitative agreement with single particle scattering theory was found, demonstrating that theory can be used for synthesizing a coating with optimum performance. Scattering theory predicts that a solar absorptance to total emittance ratio considerably under 0.1 is now possible. Author

**N65-36295#** Naval Research Lab., Washington, D. C.
**MICROACOUSTIC SYSTEM ANALYSIS BY THE MEASUREMENT OF FREE-FIELD SOUND SPEED**
W. G. Neubauer and L. R. Dragonette 3 Aug. 1964 12 p refs
(NRL-6113; AD-612094)

The microacoustic system was analyzed by measuring free-field sound speed in water. The water was contained in a 10 × 5 × 5 ft cypress rank. A pulse was transmitted from a fixed source to a receiver positioned at two different distances along a radius of the source. The distance difference of approximately one meter and the travel time over this distance were accurately measured. Sound-speed measurements were taken at 41 temperatures over a range from 16.8° to 23.10° C. The measurements led to the detection of a large error in the remote determination of large distances using a cathetometer mounted horizontally. The error was eliminated and new system designed. The ambient temperature at a given depth in the tank remained constant to within ±0.01° C for a time sufficient to make the measurements. Vertical temperature gradients were not present to a significant degree. The electronic system used was consistent and dependable. The free-field value of velocity was determined to be at least 0.2 to 0.6 m/sec lower than confined field values measured by others. R.N.A.

**N65-36305#** New York Univ., N. Y. Research Div.
**SOME SPECULATIONS ON ELECTROMAGNETIC THEORY**
H. H. Chiu 13 Jul. 1963 14 p refs
(Grant AF-AFOSR-178-64)
(NYU-AA-64-2; AD-607262)

An attempt is made to derive Maxwell's equation of an Electromagnetic field, in vacuo, from the relativitistic Liouville's equation for the photon gas. The density distribution of the photon gas is conceived as the scalar product of two complex vector functions $\overline{\chi}$ and $\overline{\chi}^*$, which are conjugate to each other. By limiting the observation to be isotropic, in a sense described by K. Kondo, it was found that half of the sum of two complex wave functions is identified as the electric field intensity, while half of the difference of the two functions, divided by $\sqrt{-1}$ is the magnetic field intensity. Two vector wave functions satisfy Maxwell's equation of Electromagnetic wave in vacuo. Author

**N65-36396*#** Syracuse Univ. Research Inst., N. Y. Dept. of Chemical Engineering and Metallurgy.
**ADHESION BETWEEN ATOMICALLY PURE METALLIC SURFACE, PART IV Semiannual Report No. 2**
Douglas V. Keller, Jr. Jul. 1965 13 p refs
(Grant NsG-483)
(NASA-CR-67505; SURI-MET-1100-658SA) CFSTI: HC $1.00/MF $0.50 CSCL 20C

Activities are discussed in an experimental investigation of physical adhesion; measurement of true contact area during the adhesion process; and effect of adsorbed, or impurity species on metal–metal adhesion. It is reported that dispersion and field forces were studied to a limited extent for quartz and certain metal specimens in air. A detailed description is given for a system which was designed and constructed to make physical adhesion measurements between atomically clean metal plates. The main problem in obtaining quantitative solid–solid adhesion data is the lack of a reliable technique to estimate the amount of surface contaminant at the instant a force measurement is in progress. It is reported that a system was studied that shows promise for the solution of this problem. The system is illustrated schematically, and described in detail. In the area of surface impurities, an investigation is reported which examines the utilization of contact potential measurements as a method of surface characterization prior to adhesion measurements. C.T.C.

**N65-36402#** College of Aeronautics, Cranfield (England).
**AN APPROXIMATE ASSESSMENT OF THE STATIC AND DYNAMIC PERFORMANCE OF THE KEARFOTT BALL VALVE, PAPER C2**
R. E. Bidgood [1965] 24 p refs Presented at the 1st Intern. Conf. on Fluid Logic and Amplification, Brit. Hydromech. Res. Assn. and the Coll. of Aeron., Cranfield, England, 8–9 Sep. 1965 CFSTI: HC $1.00/MF $0.50

An attempt has been made to describe the performance of a ball valve switching device in terms of the electrical analogue. The performance of the basic unit is given in terms of simple mathematical functions for both the static and dynamic case. The theory involved in this paper has enabled us to design and develop some of the more complex circuits needed for practical problems. Author

**N65-36455#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**DYNAMICS OF IDEAL SUSPENSIONS APPLIED TO ROTATING BODIES IN SPACE**
Paul H. Savet Jun. 1965 42 p
(RE-216J)

The general problem of a perfect frictionless suspension of a rotatting body with two degrees of freedom mounted upon a rotating shaft of spin axis deflection is analyzed. It is found that frictionless suspension is achievable by dyanamic means at a particular spin rate under a variety of design conditions. Essentially, these consist of combining the positive restoring torque of an elastic mounting with the negative spring effect created by an auxiliary element attached to the rotor, and rotating the former in synchronism with the latter. The auxiliary body also exhibits an additional periodic motion which is determined by the particular constraints imposed. In all the possible design approaches analyzed, the periodically varying torques created by the swiveling auxiliary element experience a phase sensitive demodulation which results in a steady state negative torque. This counteracts the positive restoring torque of suspension. Author

**N65-36469#** Boeing Scientific Research Labs., Seattle, Wash.
**ROUTH'S CRITICAL MASS RATIO AT THE TRIANGULAR LIBRATION CENTERS**
André Deprit Jul. 1965 51 p refs *Its* Math. Note No. 418
(DI-82-0453)

Routh's criterion concerning the existence of periodic solutions around the triangular libration centers is shown to be valid only at the first order. For mass ratios greater than Routh's critical value, the analytical relations between the mass ratio and the lower bound of the orbital parameter is expanded in power series up to the fourteenth order. The corresponding d'Alembert series representing the limiting periodic orbits up to the same order are used to provide approximate initial conditions for a numerical integration method. For mass ratios as high as 0.044 (in canonical units), the Jacobi constant of the limiting orbits is a slightly increasing function of the mass ratio; their characteristic exponents are of the stable type. As the mass goes on increasing, the multipliers keep moving on the unit circle in the complex plane from the real unit point to its opposite. The orbits evolve from infinitesimal ellipses centered at $L_4$ into large size asymmetrical ovals around that point. Author

N65-36514# New Mexico Univ., Albuquerque.
**ULTRASONIC MEASUREMENTS ON PLASTIC CRYSTALS NEAR THE SOLID-SOLID TRANSFORMATION POINTS**
Carl E. Scheie and John R. Green [1964] 7 p
(Contract AT(29-1)-789)
(SC-DC-64-2060; CONF-641210-2)

Ultrasound velocities were measured by transit times on polycrystalline samples of cyclohexane, cyclohexanol, and camphene at temperatures above and below their respective transformation points. All the compounds showed a decrease in velocity at a given temperature as a result of repeated transformations. Both cyclohexane and cyclohexanol had a linear variation of the velocity with temperature; camphene showed a gentle easing into the transformation at −120° C. Increases in velocities with temperatures were associated with increases in lattice binding. The equations of motion in a cubic solid were solved and in general two transverse modes and one longitudinal mode were established. G.G.

N65-36595# Technische Hogeschool, Eindhoven (Netherlands).
**A STATISTICAL STUDY OF PHYSICAL CLASSROOM EXPERIMENTS**
John Mandel [1965] 92 p refs CFSTI: HC $3.00/MF $0.75

A study was made of three simple physical classroom experiments from a statistical point of view, and the feasibility of using these experiments as basic examples in teaching a course in statistics was investigated. The experiments used were: the determination of the acceleration of gravity by means of a pendulum; the determination of the absorption coefficient, for gamma radiation, of lead and aluminum, using a Geiger-Müller counter; and the determination of the focal length of a lens, using two different methods. Analysis and interpretation of the results of these experiments in terms of the physical theory underlying them are presented, in addition to some theoretical aspects of the error analysis and its bearing on a correct evaluation of exerpimental results. G.A.L.

N65-36678# France. Ministère de l'Air, Paris.
**THEORETICAL AND EXPERIMENTAL STUDY OF THE GLOTTAL SIREN AND VARIOUS CONTRIBUTIONS TO THE THEORY OF HORNS [ETUDE THEORIQUE ET EXPERIMENTALE DE LA SIRENE GLOTTIQUE ET CONTRIBUTIONS DIVERSES A LA THEORIE DES PAVILLONS]**
Raoul Husson 1965 132 p refs In FRENCH
(Rept.-416) CFSTI: HC $4.00/MF $1.00

Theoretical studies are presented concerning the acoustical functioning of the glottal siren and various kinds of horns. Included are discussions and experimental studies of the pharyngo–buccal horn, absorbing horns, time-variable horns, time-independent horns, and turbulent diffusion horns. Transl. by G.A.L.

N65-36693# Hokkaido Univ., Sapporo (Japan). Faculty of Engineering.
**BULLETIN OF THE FACULTY OF ENGINEERING, NO. 36**
[1963] 55 p refs In JAPANESE; ENGLISH summary CFSTI: HC $3.00/MF $0.50

CONTENTS:

1. ANALYSIS OF THE COMBINED HYDRO-THERMAL POWER SYSTEM INCLUDING FLOW-INTERCONNECTED SUBSYSTEMS BY GRADIENT METHOD Toichiro Koike and Eiichi Miyamoto p 1–21 refs

2. AN EXPERIMENTAL STUDY ON THE PERFORMANCE OF A SMALL GAS TURBINE Takeshi Saito and Ken-ichi Ito p 23–43

3. THE RELATION BETWEEN THE START OF TRANSFORMATION AND APPLIED STRESS ON 18-8 TYPE AUSTENITIC STEEL Iwao Hagiwara, Shogo Kanazawa, and Yoshio Tomioka p 45–55 refs

N65-36719# Istituto Universitario Navale, Naples (Italy).
**ABSORBING E.M. MATERIALS (PLANNING AND MEASURING TECHNIQUES) Annual Summary Report, 1 Feb. 1964–31 Jan. 1965**
28 Feb. 1965 27 p
(Contract AF 61(052)-589)
(ASR-3; AD-463717)

The study of artificial dielectrics of the obstacle and mixture type is presented. Cone-tapered absorbers were theoretically and experimentally examined. The measurement techniques under waveguide and parallel-plate conditions were refined. Author

N65-36736# Naval Research Lab., Washington, D. C.
**THE WETTING OF GOLD AND PLATINUM BY WATER**
K. W. Bewig and W. A. Zisman 10 Aug. 1965 8 p refs
(NRL-6311; AD-620339) CFSTI: $1.00

When a sessile drop of pure water is placed on a clean surface of pure polished gold or platinum, it will spread spontaneously over the metal and exhibit a zero contact angle. However, in order to rid surfaces of these metals of adsorbed hydrophobic contaminants, it is necessary to heat them to white-hot temperatures in flowing streams of high-purity hydrogen, nitrogen, argon, krypton, or air. Such a treatment gives surfaces which are completely wetted by pure water and exhibit zero contact angles in gases freed from trace contaminants by an adsorbent cold trap. However, prolonged exposure of the metals to these gases renders them nonwetting because of the gradual adsorption of trace hydrophobic contaminants present in the gas streams. Author (TAB)

N65-36849# Princeton Univ., N. J. Dept. of Civil Engineering.
**SHEAR PHENOMENA IN GRANULAR RANDOM PACKINGS Scientific Report No. 2**
Thomas F. Herbst and Hans F. Winterkorn 30 May 1965
207 p refs *Its* Soil Eng. Res. Ser. No. 2
(Contract AF 19(628)-2414)
(AFCRL-65-370; AD-619398)

Investigation concerns engineering consequences of theory of the macromeritic solid, liquid and solution states. Because of need to know dependability of shear test data, physical factors influencing them are critically examined. Results are utilized in design of new semiautomatic direct shear tester. Data obtained with modified old machine and new semiautomatic tester are theoretically evaluated. The factor C in the original Winterkorn equation $\tan \phi = C/e - e_{min}$ is shown to correspond to the product $(\tan \phi_{crit})(e_{crit} - e_{min})$ with a better physical definition of $e_{min}$ than hitherto available. Author

N65-36897*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
**A SUPERCONDUCTING MAGNETIC BOTTLE**
James C. Laurence and Willard D. Coles Washington, NASA, 1965 15 p refs Presented at the Cryogenic Eng. Conf., Houston, 23–25 Aug. 1965
(NASA-TM-X-52115) CFSTI: HC $1.00/MF $0.50 CSCL 21L

A superconducting magnetic bottle consisting of two mirror coils, a central field coil, and a cylindrical cusp field coil, has

been designed and constructed of Nb-25% Zr cable. The configuration was designed to investigate the problems involved in using superconducting materials to produce magnetic fields useful for experiments in plasma physics. Fields as intense as 50 kG have been produced in 4-in. inside diameter coils with a superimposed quadrupole cusp field of 5 to 10 percent of the center field and a mirror ratio of 2. Author

# 24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

**N65-35810#** Air Force Cambridge Research Labs., Bedford, Mass.

**CALCULATED CROSS SECTIONS FOR ATOMIC DISPLACEMENTS PRODUCED BY ELECTRONS IN THE 1.0–3.0 MeV ENERGY RANGE**

Edward A. Burke, Niel J. Grossbard, and Lester F. Lowe Apr. 1965 24 p refs *Its* Phys. Sci. Res. Papers No. 99 (AFCRL-65-286; AD-616245)

In deriving atomic displacement threshold energies from electron bombardment data it is necessary to employ numerical values of the electron scattering cross section calculated over a range of electron energies. For relativistic energies the Mott-Rutherford cross-section formula may be used. A computer program was developed to evaluate this formula for any value of atomic number and electron energy. In this report the program is described and numerical values presented for atomic numbers 23, 29, 45, 46, 73, 74, 77, 78, and 79; electron energies between 1.0–3.0 MeV; and appropriate assumed threshold values. Author

**N65-35839*#** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**ELASTIC AND INELASTIC SCATTERING OF 40-MeV ALPHA PARTICLES FROM EVEN TIN ISOTOPES**

Norton Baron, Regis F. Leonard, John L. Need, and William M. Stewart Washington, NASA, Oct. 1965 45 p refs (NASA-TN-D-3067) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Angular distributions were measured for alpha elastic and inelastic scattering by isotopically enriched targets of $^{116}Sn$, $^{118}Sn$, $^{120}Sn$, and $^{122}Sn$ using the 40-MeV alpha beam of the NASA 60-inch cyclotron. In each isotope, only two strongly excited states were observed. Their energies were about 1.2 and 2.4 MeV above the ground state. The elastic angular distributions were analyzed using both the Blair-Fraunhofer black-disk method and the optical model. These analyses are consistent with the concept that the elastically scattered particles result from surface reactions of a direct nature. The inelastically scattered groups of alpha particles were analyzed using a distorted waves Born approximation (DWBA). The results of these calculations predict the first excited state of each isotope to have a spin of two and positive parity. Similarly, the second excited state of each isotope is predicted to have a spin of three and negative parity. In addition, the angular distributions of the ground state, first excited state, and second excited state of each isotope are observed to obey the Blair phase rule. Deformation parameters were extracted from the DWBA calculations and are found to be in agreement with those obtained by Coulomb excitation experiments. Author

**N65-35851** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**INVARIANT-GROUP SOLUTIONS OF EQUATIONS OF NONSTATIONARY BEAM OF CHARGED PARTICLES**

V. A. Syrovoy *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 1–33 refs (See N65-35850 24-23)

Equations of a nonrelativistic monoenergetic nonstationary charged particle beam, with the same value and sign of specific charge in an arbitrarily oriented external magnetic field H, are considered. It is assumed that in every point the vector of speed is a single valued function. It was found that the basic group of equations for the space beam appeared to be much wider at H = 0. Flat flows, described by H solutions of rank one and two, are developed in detail. A series of analytic solutions are given which describe certain processes in arrangement with planar, cylindrical, and spherical geometry. Focusing electrodes are determined for several nonstationary beams. Certain results, related to the calculation of the basic group of relativistic beam equations, are derived when it is possible to disregard the radiation of the moving charges. C.T.C.

**N65-35852** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**NEUTRALIZATION OF ION BEAMS**

V. A. Levin *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 34–41 refs (See N65-35850 24-23)

The problem of neutralization of an ion beam at the longitudinal introduction of electrons is considered for both stationary and nonstationary cases, taking into consideration their friction against ions and radiation. It is shown that the calculation of friction automatically leads to equality of electron and ionic currents. It is also shown that development of flow occurs in such a way that extruded electron current is equal to ionic current even in the absence of dissipation. C.T.C.

**N65-35854** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**RELAXATION OF VIBRATIONAL ENERGY IN A BINARY MIXTURE OF DIATOMIC GASES**

A. I. Osipov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 55–64 refs (See N65-35850 24-23)

The problem of an exact description of the process of vibrational relaxation in a binary mixture of diatomic molecules is considered. Starting from a system of equations representing balance for a number of molecules of a binary mixture of diatomic gases on every vibrational level, a relaxation equation is derived. This is shown to satisfy previously determined experimental results. A brief discussion of the physical interpretation of the derived equation is included. C.T.C.

**N65-35888** Max-Planck-Institut für Kernphysik, Heidelberg (West Germany).

**ISOBARS, FIREBALLS, AND EXTENSIVE AIR SHOWERS**

K. Sitte *In* Comision Nacl. de Invest. Espaciales Intern. Years of the Quiet Sun, Vol. 1 1965 19 p refs (See N65-35083 24-13) CFSTI: HC $4.00/MF $0.75

The question of whether the properties of high-energy interactions can be understood on the basis of a common model which would permit quantitative differences in the results of collisions at air shower energies but demand qualitative identity of the processes, is examined. The established features of both jets and air showers are summarized, and the idea of a common model is used. In formulating this model these established features are considered, and parameters are obtained from a comparison with jet data. The electron component and

the penetrating component in extensive air showers are also studied, and the procedures adopted for the calculations are given. Results suggest that isobar formation and deexcitation by rapid emission of a few high-energy isobar secondaries seem to play an important part in the shower development. However, it is more likely to be accompanied by the formation of two comparatively fast fireballs, and lower pionization multiplicity, than by the slow fireballs of the pure isobar model. M.G.J.

**N65-35954*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**EQUATION OF STATE OF MATTER AT SUPERNUCLEAR DENSITY**
E. R. Harrison Washington, NASA, Oct. 1965 8 p refs (NASA-TN-D-3020) CFSTI: HC $1.00/MF $0.50 CSCL 20H

Using a vector meson model, Zel'dovitch has shown that at very high densities, the pressure tends to equal $\epsilon$, where $\epsilon$ is the energy density. By modifying Zel'dovitch's model to avoid certain unrealistic simplifications, and by assuming that the higher masses of the meson hierarchy progressively predominate in the interactions as the density increases, it is shown that the pressure, in fact, tends to equal $\epsilon/3$. Author

**N65-35955*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**PARTIAL WAVE CALCULATION OF THE DIATOMIC MOLECULE $(HeH)^{++}$**
Harris Rabinovich Washington, NASA, Oct. 1965 18 p refs (NASA-TN-D-3050) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The solutions to the Schrödinger equation for the diatomic molecule $(HeH)^{++}$ in the Born–Oppenheimer approximation have been expanded in a series of partial waves and radial equations have been derived. These radial equations have been solved numerically for the first three orders of approximation and the energy eigenvalues and wavefunctions have been obtained for seven different $\Sigma$ states at various values of the internuclear separation. The numerical wavefunctions have been used to calculate dipole transition integrals and dipole moments. Author

**N65-35979*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**HYPERFINE SPLITTINGS AND $g_F$ VALUES OF METASTABLE $H_2$**
Lue-Yung Chow Chiu (Catholic Univ.) Oct. 1965 22 p refs Submitted for Publication
(NASA-TM-X-55297; X-641-65-387) CFSTI: HC $1.00/MF $0.50 CSCL 20H

The energy arising from the hyperfine interaction, the interaction with the magnetic field and the cross term between them have been studied for ortho $H_2$ at $c^3\pi_u$ state. The cross term gives rise to a first order correction of the $g_F$ values which accounts for the discrepancies between the theoretical zero$^{th}$ order $g_F$ and the experimental values. The interactions are expressed as products of irreducible spherical tensors and Racah's method is used to derive all the diagonal and off diagonal matrix elements. The case of rotational level, $N = 1$, is presented in detail. The coupling constants of hyperfine structure have been evaluated by using a single configuration electronic wave function for $c^3\pi_u$ state of $H_2$. Author

**N65-35994#** Oak Ridge National Lab., Tenn. Neutron Physics Div.
**FAST-NEUTRON SCATTERING FROM SMALL CYLINDERS OF STEEL, ALUMINUM, AND GRAPHITE**
John C. Courtney (Ph.D. Thesis—Catholic Univ. of Am.) Jul. 1965 100 p refs Sponsored in part by the Army
(ORNL-TM-1156; AD-618922)

Time-of-flight methods were used to measure the spectra of fast neutrons scattered at angles of 20, 45, 70, 110, and 160 deg from the incident beam by small cylinders of steel, aluminum, and graphite. The energy spectrum of the neutrons approximated a fission spectrum. Some of the neutrons struck the scattering sample, which was placed 13 in. from the source, passed through a system of collimators, down a drift tube, and into a liquid scintillator fast-neutron detector. Pulse-shape discrimination circuitry was used to eliminate pulses due to any gamma-ray background. Measured source spectra were used as input for Monte Carlo calculations of the scattered neutrons, and the results were compared with measured scattered spectral intensities. The calculations and experiments, integrated over energy, agreed within 16%. Since the spectral shape was satisfactorily reproduced, it is believed that the uncertainty in the measurement of the integrated fast-neutron flux by foil activation accounts for any discropancies. These comparisons indicate that the cross-section library for these elements is adequate to handle neutron scattering calculations. Author (TAB)

**N65-36058** Nuclear Power Field Office, Fort Belvoir, Va.
**THEORETICAL INTENSITY OF A COLLIMATED BEAM**
Garrett V. Sidler *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 145–153 ref (See N65-36050 24-19)

Basic concepts in the derivation of the intensity of a collimated beam are shown as a function of the collimator dimensions. Isotropic emission is assumed and attenuation of the beam by air and scattering are neglected. All angles are measured in absolute values; the equations provide the sign changes where necessary. Formulas are derived which can determine the theoretical intensity of the neutron beam as well as yield optimum dimensions of the collimator. Both the neutron spectrometer and the primary collimator are illustrated, a typical integral is given, and intensity versus number of channels is plotted through the use of the derived equations. M.W.R.

**N65-36120#** Atomic Energy Commission, Washington, D. C. Div. of Technical Information.
**RADIATION PHYSICS. II: NEUTRON AND GAMMA DOSIMETRY [RADIATSIONNAYA FIZIKA. II: DOSIMETRIYA NEITRONOV I GAMMA–LUCHEI]**
E. M. Kashlinskii, D. Ya. Gubatova, K. K. Shvarts, and Ya. Zh. Kristapson, ed. Sep. 1965 120 p refs Transl. into ENGLISH of "Radiatsionnaya Fizika. II: Dosimetriya Neitronov i Gamma-Luchei" Riga, Publ. House of the Acad. of Sci. Latvian SSR, 1964 p 3–115
(AEC-TR-6604) CFSTI: $4.00

A collection of articles is presented on the problems of techniques in measuring neutron fluxes of reactors; methods of determining the tissue doses of neutrons and gamma rays, including the depth doses in biological specimens; and certain problems of procedure for dosimetric control of fast neutrons. Materials on the chemical dosimetry of mixed gamma–neutron fields are given. A small-size radiometer, designed for laboratory, shop, and field measurements of fast and intermediate neutrons and gamma radiation in mixed fluxes is described. C.T.C.

**N65-36123#** IIT Research Inst., Chicago, Ill. Technology Center.
**A STUDY OF THE FEASIBILITY OF USING SCINTILLATING FIBERS FOR LOW ENERGY BETA COUNTING Final Report, 1 Feb.–Dec. 1964**
G. Hardie, C. C. Preston, and J. J. Ezop Washington, AEC, 5 Mar. 1965 61 p refs
(Contract AT(11-1)-578)
(IITRI-578P26-8) CFSTI: $3.00

A study was made of various scintillating fiber configurations, suitable for counting low energy betas, which could be easily and reproducibly emptied and filled and yet which would have a reasonably high counting efficiency. A detector was constructed which offered advantages in terms of low cost and simplicity of construction. Procedures were developed for filling and emptying this detector. Much higher efficiencies have been obtained by closer spacing of the fibers, with sacrifice of the ease with which the detector was emptied and filled. The problem of detecting the very low energy tritium betas with this type of detector was investigated. For highest efficiency, it is recommended that both cooling and the coincidence technique by employed. Construction details of this detector type are given in this report. Author

**N65-36143#** Argonne National Lab., Ill. Physics Div.
**[EXPERIMENTAL NUCLEAR PHYSICS, MASS SPECTROSCOPY, AND THEORETICAL PHYSICS] Summary Report, Jan.–Mar. 1964**
Lowell M. Bollinger [1964] 54 p refs
(Contract W-31-109-ENG-38)
(ANL-6877)

Studies are presented in experimental nuclear physics, mass spectroscopy, and general theoretical physics. Investigations in excited state spin based on $(n,\gamma\gamma)$ angular-correlation measurements on medium weight nuclei are given. The $B^{11}(n,\gamma)B^{12}$ cross sections were determined at low energies. Under an electron–neutron interaction area, $He^3$–Ne–$CH_4$ mixtures were investigated in a proportional counter for thermal neutrons. Mass spectrometric studies of a laser-produced graphite jet are presented. The S-state interactions and nuclear coupling schemes, and the quantum theory of measurement are considered in the area of theoretical physics. C.T.C.

**N65-36153#** Texas Univ., Austin. Dept. of Physics.
**THE PHYSICS OF METASTABLE SYSTEMS Final Report, 1 Feb. 1963–31 Jan. 1964**
W. W. Robertson [1964] 7 p refs
(Grant AF-AFOSR-273-63)
(AFOSR-65-1047; AD-619099)

Research results in the following areas are briefly summarized: dissociation energy of

$$HE_2^+(^2\Sigma_u^+);$$

potential curve of the metastable helium molecule; a flow-system and burner for observing selective excitation of spectra by metastable species in the afterglow of a helium discharge; and cyclotron resonance in slightly ionized gases. A list of publications, which describe the research more fully, is included. TAB

**N65-36176#** RAND Corp., Santa Monica, Calif.
**RAYLEIGH AND RAMAN SCATTERING IN MOLECULAR NITROGEN**
Horace A. Ory and Harold T. Yura Aug. 1965 30 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4664-ARPA; AD-620169)

The static polarizability and the cross sections for Rayleigh and rotational Raman scattering in molecular nitrogen are calculated by a direct perturbation technique. This approach is based on an effective intermediate state energy that is approximated closely through knowledge of potential energy curves for the nitrogen electronic states. Results obtained for the static polarizability agree with experimental values within about 20 percent and represent considerable improvement over earlier calculations. The cross section for Rayleigh scattering is given for various polarizations and scattering angles, and is found to agree with experiment within about 30 percent. The rotational Raman forward scattering cross section is obtained as a function of rotational level, and Stokes scattering from the J = 6 level is shown to be most easily stimulated in Raman lasers at room temperature, for illumination by ruby laser light. Author

**N65-36245#** Cornell Univ., Ithaca, N. Y. Dept. of Physics.
**A MODEL FOR ATOMIC EXCITED STATES II EIGENVALUES AND EIGENFUNCTIONS Technical Report No. 7**
E. J. McGuire Jul. 1965 32 p refs
(Contract DA-31-124-ARO(D)-43)
(AROD-2810-18; AD-614533)

A model for one electron excited states is described which can be used in calculations of atomic photoabsorption processes in the soft X-ray region. Author

**N65-36333#** European Atomic Energy Community, Brussels (Belgium).
**(n,2n) EXCITATION FUNCTIONS FOR NUCLEI AROUND Z = 28**
H. Liskien and A. Paulsen Jul. 1965 8 p refs Presented at the Intern. Conf. on the Study of Nucl. Structure with Neutrons, Antwerp, 19–23 Jul. 1965
(EUR-2456.e) CFSTI: HC $1.00/MF $0.50

Excitation functions for (n, 2n) reactions of $Mn^{55}$, $Co^{59}$, $Ni^{58}$, $Cu^{63}$, $Cu^{65}$, and $Zn^{64}$ were determined experimentally with an accuracy of about ±6%. These experimental results are compared with theoretical calculations based on the complete statistical concept of the compound nucleus model. The discrepancy between theoretical and experimental results is shown to be consistent with the inaccuracy of the knowledge of level density parameters. Author

**N65-36337#** Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaire.
**CALIBRATED RADIOACTIVE SOURCES—ABSOLUTE MEASUREMENTS USING A 4 $\pi$ $\beta$-$\gamma$ APPARATUS [SOURCES] ETALONS DE RADIOACTIVE—MEASURES ABSOLUES AU MOYEN D'UN ENSEMBLE 4 $\pi$ $\beta$-$\gamma$]**
Paulette Benoit and Claude Philis Mar. 1965 70 p refs In FRENCH
(CEA-R-2711) CFSTI: HC $3.00/MF $0.50

The principle of the standardization of the radioisotopes by the 4$\pi$ $\beta$-$\gamma$ coincidence method is reviewed. Some theoretical examples are given emphasizing instrumental coincidences and their corrections. The experimental apparatus is described, and the choice of experimental conditions for many isotopes is discussed. Results are given and discussed. The preparation of the source is described. Author

N65-36338# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
**EVAPORATION OF NEUTRONS FROM STRONGLY EXCITED CLOSED SHELL $f_{7/2}$ NUCLEI IN INELASTIC NEUTRON SCATTERING**
Jozef Koralewski, Tadeusz Kozlowski, Zbigniew Moroz, and Jolanta Wojtkowska Dec. 1964 17 p refs
(INR-591/1A/PL) CFSTI: HC $1.00/MF $0.50

Continuous spectra of neutrons inelastically scattered on $V^{51}$, $Cr^{52}$, and $Ni^{58}$ have been measured with time-of-flight spectrometer at an incident energy of 14.1 MeV. The spectra were observed above the maximum energy of neutrons from the /n,2n/ reaction. From these spectra, the level density parameters T and a have been calculated. The results of investigations and comparisons with other measurements are as follows: (1) the dominant reaction mechanism in the measured energy range is the evaporation of neutrons, (2) the Fermi gas model gives a good approximation for nuclei with closed shell, (3) there is evidence that the effect of pairing is insignificant at the studied exitation energy, and, (4) the optical model reaction cross section seems to be a good expression for the inverse reaction cross section. Author

N65-36340# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions.
**EXCITATION FUNCTIONS AND ISOMERIC YIELD RATIOS FOR THE REACTION $C^{12}(N^{14},2p)Na^{24m,g}$**
K. F. Alexander, H. F. Brinckmann, G. Lang, and H. Rotter [1965] 7 p refs
(JINR-E-2012) CFSTI: HC $1.00/MF $0.50

Absolute cross sections for the reaction $^{12}C(^{14}N, 2p)$ $^{24}Na$ leading to the 20-msec isomeric state and the 15-hr ground state of $^{24}Na$ were measured, using a pulsed external ion beam from the cyclotron U-150. Bombarding energies varied between 20 and 65 MeV. The isomeric yield ratio shows a pronounced maximum at about 35 MeV bombarding energy. Possible interpretations of this behavior are discussed. Author

N65-36341# Joint Inst. of Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
**AN ELECTROSTATIC FIELD OF UNIFORMLY CHARGED VOLUMES OF A CYLINDRICAL CONFIGURATION**
V. I. Danilov and I. V. Puzynin 1965 21 p refs In RUSSIAN
(JINR-P-2131) CFSTI: HC $1.00/MF $0.50

The electrostatic field of unfirormly charged cylindrical configuration was calculated. The general case of these configurations is a party of a cylindrical ring with a central angle of $2\theta_0$. The potential and the components of the field were determined with the aid of a specially constructed function $U_0$ satisfying the Laplace equation. Some particular cases of the general solution were considered—the electrostatic field of a cylindrical ring, of a sector, of a cylinder with finite dimensions. Their limiting cases at semi-infinite and infinitely large height were considered. The results of the work may be used to estimate the effect of the spatial charge of a bunch of accelerated particles on the stability of their motion. They may also help to calculate the maximal intensity attainable in different accelerators. Author

N65-36342# Joint Inst. for Nuclear Research, Dubna (USSR).
**A DETERMINATION OF RELATIVE PROBABILITIES OF THE $K^0 \rightarrow 3\pi$ DECAYS**
M. Anikina et al 1965 7 p refs In RUSSIAN Submitted for Publication
(JINR-P-2090) CFSTI: HC $1.00/MF $0.50

Data on the relative probabilities of the $K_2^0 \rightarrow 3\pi^0$ decays were obtained, and an estimate is given for $K_2^0 \rightarrow \pi^+\pi^-\gamma$, finding $[W(K_2^0 \rightarrow 3\pi^0)/W(K_2^0 \rightarrow \text{charged particles})] = 0.28 \pm 0.08$, $[W(K_2^0 \rightarrow \pi^+\pi^-\pi^0)/W(K_2^0 \rightarrow \text{charged particles})] = 0.18 \pm 0.06$, and $[W(K_2^0 \rightarrow \pi^+\pi^-\gamma)/W(K_2^0 \rightarrow \text{charged particles})] < 0.036$. The $K_2^0 \rightarrow 3\pi^0$ decay was detected by the Dalitz pair from $\pi^0$, and $K_2^0 \rightarrow \pi^+\pi^-\pi^0$, $\pi^0 \rightarrow \gamma e^+e^-$ by the four-prong events with $\pi^+\pi^-$ mesons and the Dalitz pair. The ratio $[\Gamma_2(3\pi)/\Gamma(3\pi)] = 1.19 \pm 0.23$ is in agreement with the selection rule $|\Delta I| = 1/2$. Author

N65-36355# Joint Inst. for Nuclear Research, Dubna (USSR).
**GENERAL PRINCIPLES OF THE LOCAL THEORY AND THEIR EXPERIMENTAL SIGNIFICANCE [OBSHCHIE PRINTSIPY LOKAL'NOI TEORII I IKH EKSPERIMENTAL'NYE SPEDSTVIYA]**
A. A. Logunov 1964 18 p refs In RUSSIAN Presented at the 1964 Intern. Conf. on High Energy Phys., Dubna, USSR, 5–15 Aug. 1964
(JINR-P-1793; CONF-550-72) CFSTI: HC $1.00/MF $0.50

The axiomatic approach of the quantum field theory has been undergoing a marked development. The approach is based primarily on the Heisenberg quantum field. The theory requires invariance with respect to the inhomogeneous Lorentz group. When examining the scattering problems of the field theory, the concept of the asymptotic, free "in and out" fields must be applied. The studies carried out on the basis of the microcausality principle and the analytical properties of the scattering amplitudes are examined. Attention was given to the asymptotic correlation between amplitudes of elastic and inelastic processes and the particle-generation cross sections. A recent paper on inelastic processes involving particle generation was also considered, examining the $\pi$ meson-nucleon collisions. It is shown that taking into account the electromagnetic interactions does not change the conclusions on the parity of the differential cross sections of particles and antiparticles in the high-energy range. N.S.A.

N65-36356# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
**ELASTIC SCATTERING OF 3.15 Gev/c POSITIVE PIONS ON PROTONS AT 180° [UPRUGOE $\pi^+$-p RASSEYANIE NA UGOL 180° PRI IMPUL'SE 315 Gev/c]**
I. A. Savin, A. S. Volvenko, B. N. Gus'kov, M. F. likhachev, A. L. Lyubimov et al 1965 7 p refs In RUSSIAN
(JINR-P-2127) CFSTI: HC $1.00/MF $0.50

The differential cross section for elastic 3.15 Bev/c $\pi^+$-meson scattering on protons at 180° was measured. The value of the cross section was found to be 91 $\pm 1$ $\mu$barn-steradian$^{-1}$, which gives evidence for an existence of pronounced peak in elastic $\pi^+$-p backward scattering. Author (NSA)

N65-36357# Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.
**MECHANISM OF THE $\pi^-, \pi^-$ n REACTION [O MEKHANIZME $(\pi^-, \pi^-$ n REAKTSII]**
V. M. Kolybasov 1964 14 p refs In RUSSIAN; ENGLISH Abstract *Its* Rept.-97
(NP-15048) CFSTI: HC $1.00/MF $0.50

Total cross sections of the reaction $C^{12}$ $(\pi^-, \pi^-n)$ $C^{11}$ in the bombarding energy range from 40 to 600 MeV in the pole approximation was calculated. The calculated excitation function is in agreement with experimental data. The reduced vertex part (neutron width) of the virtual decay $C^{12} \rightarrow C^{11} + n$

was found out of absolute values of the cross section. Its value turns out to be equal to that obtained from the pick-up reaction $C^{12}(p,d)C^{11}$. The facts mentioned above confirm a hypothesis of the pole mechanism of the given reaction. Author

**N65-36358#** Gosudarstvennyi Komitet Po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi Eksperimental'noi Fiziki.

**ANGULAR CORRELATION BETWEEN $\pi$-MESONS AND LEPTONS AND DETERMINATION OF FORM FACTORS IN K-DECAY**

I. S. Tsukermai 1964 8 p refs In RUSSIAN; ENGLISH Abstract Its Rept.-281

(NP-15252) CFSTI: HC $1.00/MF $0.50

The form of the angular correlation curves between pion and lepton directions in $K_{\mu 3}$ decay is shown to be sensitive to the choice of one of two possible values of the form factor ratio. Author

**N65-36365#** Atomic Energy of Canada, Ltd., Chalk River (Ontario).

**ON THE HIGH FREQUENCY CHARACTERISTICS OF A HELIX LINEAR ACCELERATOR FOR PROTONS IN THE ENERGY RANGE 0.15 TO 1 MeV**

Friedrich Saure Sep. 1965 11 p Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 18, no. 3, 1964 p 150–152

(AECL-2288) CFSTI: HC $1.00/MF $0.50

The accelerator sections for a helix linear accelerator are described that maintain mechanical stability with a minimum of supporting material. The copper tube waveguides are secured by three teflon combs that are pressed into the coil, and the waveguides are suspended from the outer conductor by three rows of quartz threads under tension. It was shown that this accelerator needs only 10 kW to accelerate protons from 0.15 to 1 MeV at an accelerating length of 4.80 m and an operating frequency of 20 Mc/s. G.G.

**N65-36375#** Società Ricerche Impianti Nucleari, Saluggia (Italy).

**PRODUCTION OF CARRIER-FREE $^{54}$Mn FOR THE IN-PILE IRRADIATION OF IRON [PRODUZIONE DI $Mn^{54}$ CARRIER-FREE PER IRRAGGIAMENTO DI FERRO IN REATTORE]**

G. B. Fasolo, R. Malvano, and U. Rosa Brussels, EURATOM, Jun. 1964 34 p refs In ITALIAN; ENGLISH summary (Contract EURATOM-026-62-4 RISI)

(EUR-1641.i) CFSTI: HC $2.00/MF $0.50

In order to develop a method for producing carrier-free $^{54}$Mn for the in-pile irradiation of pure iron, a study has been carried out on the following points: evaluation of the production yield by checking the $\sigma f(n,p)$ on $^{54}$Fe and tracing the fast flux in certain RSI reactor irradiation positions; selection of the material for irradiation by radioactivation analysis of various types of pure iron, with particular reference to the determination of the concentration of manganese impurities (assessment of $^{54}$Mn specific activity obtainable); and selection and development of an effective and simple radiochemical separation technique for $^{54}$Mn, based on the extraction of iron with solvents (isopropyl ether) and the subsequent purification of the manganese by exchange on an anionic resin column (overall purification factor of the iron $> 1 \times 10^6$). Production trials have likewise been performed on both the $\mu$C and the mC scale. 9.5 mC $^{54}$Mn were produced and separated by irradiating 99.999% iron matrices (35 g total) for two weeks at fast fluxes of 6 to $8.5 \times 10^{12}$ n-cm$^2$-sec. The specific activity is 110 C-g Mn; less than 1 $\mu$g-ml iron is present in the final solution. Author

**N65-36414#** European Organization for Nuclear Research, Geneva (Switzerland).

**JOINT DECAY DISTRIBUTION IN DOUBLE RESONANCE PRODUCTION**

H. Pilkuhn and B. E. Y. Svensson 12 Jan. 1965 14 p refs (NP-15070) CFSTI: HC $1.00/MF $0.50

The joint decay distribution for reactions like $K^+p \to K^*N^*$ and $\bar{p}p \to \bar{N}^*N^*$ is derived in terms of the joint spin space density matrix, using helicity formalism. The predictions of the peripheral model for these distributions are briefly discussed, and a general test of the peripheral model is given for the case of parity violation in one of the decays. Author

**N65-36415#** Lyon Univ. (France).

**STUDY OF THE QUADRUPOLAR EFFECTS ON THE ENERGY LEVELS IN A $\mu$-MESIC MANGANESE ATOM [ETUDE DES EFFETS QUADRUPOLAIRES SUR LES NIVEAUX D'ENERGIE DANS UN ATOME DE MANGANESE $\mu$-MESIQUE]**

Louis Berthier (Ph.D. Thesis) Jun. 1965 22 p refs In FRENCH (NP-15089) CFSTI: HC $1.00/MF $0.50

The energy levels of the $\mu$-mesic atom caused by the monopolar potential are calculated for the case of a manganese atom that has captured a negative $\mu$ meson. It is shown that the existence of a quadrupolar potential causes a modification of these calculated energy levels. This perturbation is a method that can be used to define the size of the quadrupole moment of the nucleus. N.S.A.

**N65-36416#** Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Institut Teoreticheskoi i Eksperimental'noi Fiziki.

**WEAK INTERACTIONS OF COLLIDING ELECTRON BEAMS [SLABIYE VZAIMODEYSTIVIYA NA VSTRECHNYKH ELEKTRONNYKH PUCHKAKH]**

B. L. Ioffe, L. B. Okun, and A. P. Rudik 1964 19 p refs In RUSSIAN; ENGLISH abstract *Its* Rept. No. 246

(NP-15248) CFSTI: HC $1.00/MF $0.50

Possible experiments are discussed for the investigation of weak interactions on the electron-electron and electron-positron colliding beams at energies in the order of 100 to 1000 BeV when the weak interaction becomes strong. The main results are given in Table 1 and refer to the processes nine through 12, which occur in the second order of perturbation theory on weak interaction and are described by the graphs of Figure 2. Author

**N65-36418#** International Centre for Theoretical Physics, Trieste (Italy).

**TWO TYPES OF BARYONS IN BROKEN $(SU_3)_L \otimes (SU_3)_R$ SYMMETRY**

Fayyazuddin, M. A. Rashid, and Riazuddin (Rochester Univ.) Apr. 1965 5 p Sponsored in part by AEC Submitted for Publication

(IC/65/45) CFSTI: HC $1.00/MF $0.50

It is shown that it is possible to get F-type vector and both F- and D-type axial vector currents such that

$$G_A^D + G_A^F = G_V \quad \text{and} \quad G_A^F / G_A^D = 1$$

in the $(SU_3)_L \otimes (SU_3)_R$ symmetry limit, provided baryons do not belong to a pure representation (8,1) and (1,8) or (3,3*) and (3*,3) but to both of these representations. S.C.W.

N65-36419# Aktiebolaget Atomenergi, Stockholm (Sweden)
**STUDIES OF THE FISSION INTEGRALS OF U235 AND Pu239 WITH CADMIUM AND BORON FILTERS**
Eric Hellstrand Apr. 1965 19 p refs
(AE-181) CFSTI: HC $1.00/MF $0.50

The resonance fissions in $^{235}U$ and $^{239}Pu$ were studied using cadmium and boron filters. Fission chambers were used as detectors and the experiments were performed in beam geometry. The neutron energy distribution in the beams transmitted through the different filters was determined with a fast chopper. From the cadmium filter measurements the fission resonance integrals were determined. The values obtained were 278 ±9 b for $^{235}U$ and 301 ±10 b for $^{239}Pu$; 0.5 ev < E < 1 Mev. Complementary $^{239}Pu$ measurements were made in which the fission events were detected from the fission product activity in irradiated foils, and the value of the $^{239}Pu$ resonance integral agreed well with that obtained from the fission chamber measurement. The experiments with the boron filters yielded results which, for the thin filter, agreed well with those calculated from the cross section data given in the Karlsruhe compilation. The discrepancy was larger for the thick filter but the values did not disagree outside the common limits of error. Author(NSA)

N65-36423# European Organization for Nuclear Research, Geneva (Switzerland). Theoretical Study Div.
**WEAK INTERACTIONS**
N. Cabibbo and M. Veltman 4 Aug. 1965 86 p refs
(CERN-65-30)

Theories of weak interactions are reviewed, with the lepton current, the current of strongly interacting particles, and vector bosons discussed. Also considered are matrix element construction; the conserved vector current theory; parity, charge conjugation, and time-reversal transformations; the PCT theorem; G parity; first and second class currents; the Goldberger–Treiman relation; time-reversal invariance; and final state interactions. The theories of $SU_2$ and $SU_3$ symmetry are also reviewed, with some emphasis given to the eight-dimensional representation of $SU_3$; isospin, hypercharge, and the baryon octet; the Wigner–Eckart theorem; and the anomalous magnetic moments. The use of $SU_3$ symmetry in describing weak leptonic interaction is examined; hypotheses are given on the $SU_3$ structure of the weak vector and axial vector current; and these hypotheses are compared with the experimental data. Also included are representations for the Dirac equation, and calculations of hyperon leptonic decay. M.G.J.

N65-36465# Rochester Univ., N. Y. Dept. of Physics and Astronomy.
**ALGEBRA OF CURRENTS IN NON-ZERO MOMENTUM STATES**
M. P. Khanna, S. Okubo, and N. Mukunda (Princeton Univ.) 20 Sep. 1965 17 p refs Submitted for Publication
(Contract AT(30-1)-875)
(UR-875-96)

It has been shown that the SU(4) or SU(6) algebra of currents has no consistent solution for non-zero momentum states in the approximation of dominance of low lying intermediate states, in contrast to the case of zero momentum states investigated by several authors. Author

N65-36496# California Univ. Livermore. Lawrence Radiation Lab.
**DIFFUSION AND LOSSES OF ELECTRONS IN THE ASTRON E-LAYER**
Richard B. Nicholson and Warren Hackrotte 21 Jul. 1965 46 p
(Contract W-7405-ENG-48)
(UCRL-14275) CFSTI: $2.00

A quantitative description of the time-rate loss of relativistic electrons from the Astron E-layer was developed from the diffusion theory for small-angle scattering by neutral gas atoms. The diffusion theory was developed from the Boltzmann equation assuming axially symmetric fields through application of the multiple time perturbation theory. The limiting orbits for confinement were specified for a radial loss model which states that an electron is lost if its radius of gyration is displaced more than a critical amount from the magnetic field axis; and for an axial loss model which states that an electron is lost if its axial momentum reaches a specified critical value. Since the initial trapped distribution was not known, several assumed distributions were taken for numerical calculations. It was found that the radial loss model is not consistent with preliminary experimental data. Numerical results for the axial loss model showed better agreement but because of the variety of initial conditions the model validity is questionable. G.G.

N65-36515# Illinois Univ., Urbana.
**SEARCH FOR ANOMALOUS PHOTOPION PRODUCTION FROM HELIUM**
L. Criegee, G. Moscati, B. M. K. Nefkens, and J. H. Smith [1964] 9 p refs Supported in Part by ONR
(Contract AT(11-1)-1195)
(COO-1195-8)

An experiment on the photoproduction of charged pions from $He^4$ is described which indicates that $\pi^-$ and $\pi^+$ photoproduction proceed through similar nuclear mechanisms. A two inch diameter cylinder of liquid helium was irradiated with a collimated bremsstrahlung beam from a 300 MeV betatron. Photopions of about 117 MeC/c momentum were selected by a magnet which could be rotated about the target. A comparison of results from this experiment with those for other light nuclei shows several similarities. The $\pi^-/\pi^+$ ratio from carbon shows the same angular dependence and far enough above the threshold even the same absolute value as that found in this experiment for $He^4$. E.E.B.

N65-36519# State Univ. of Iowa, Iowa City. Inst. for Atomic Research.
**THREE-DIMENSIONAL AND ONE-DIMENSIONAL FREE-ELECTRON MOLECULAR ORBITALS**
Richard L. Hummel and Klaus Ruedenberg 3 Mar. 1965 12 p Proc. of Summer School in Theoretical Chemistry, Istanbul, 16 Aug.–6 Sep. 1964 Submitted for Publication *Its* Contribution No. 1687
(Contract W-7405-ENG-82)
(IS-1119)

The free-electron model used in molecular calculations in which the electrons form waves in a three-dimensional volume, is compared with the model used in solid-state theory, in which the electrons are confined to move along a one-dimensional multiply connected space. The three-dimensional and one-dimensional free-electron waves are compared for the case of a curved-cloud electron distribution, using the example of waves in a toroidal pillbox. The energy eigenvalues and eigenfunctions, in particular for tangential excitations, are compared with those of the corresponding one-dimensional model, for various box parameters. The deviations, in energies and wave functions, of the three-dimensional solutions from the one-dimensional model are markedly smaller than would be expected from considerations of asymptotic behavior, even for a fairly wide torus. NSA

**N65-36520#** Argonne National Lab., Ill.
**INVESTIGATION OF ADIABATIC AND NONADIABATIC SPIN REVERSAL OF THERMAL NEUTRONS [OB ISSLEDOVANII ADIABATICHESKOGO I NEADIABATICHESKOGO POVOROTA SPINOV TEPLOVYKH NEITRONOV]**
A. D. Gul'ko, S. S. Trostin, and A. Khudoklin May 1965 10 p refs Transl. into ENGLISH from Inst. of Theoret. and Exptl. Phys. Preprint No. 267 (Moscow), p 1–20
(ANL-TRANS-190)

Adiabatic and nonadiabatic reversal of the spin of polarized thermal neutrons produced by the reflection from a magnetized cobalt mirror has been investigated. Adiabatic reversal of the neutron spin in the guide magnetic fields used caused no depolarization. Nonadiabatic reversal of the neutron spin with respect to the guide field was achieved by means of a sharp reversal of the magnetic field direction produced by the current in a thin aluminum foil. The polarization flipping efficiency for foils of different sizes was measured. Author

**N65-36524#** International Centre for Theoretical Physics, Trieste (Italy).
**THE INTERNATIONAL CENTRE FOR THEORETICAL PHYSICS (1964–1965) Interim Report**
1965 11 p refs
(NP-14913) CFSTI: HC $1.00/MF $0.50

The inception of the International Centre for Theoretical Physics, the research activities of this center, and the papers published by the center are reviewed. 42 references. NSA

**N65-36530#** General Electric Co., Schenectady, N. Y. Knolls Atomic Power Lab.
**COMBINED R-FUNCTION AND OPTICAL POTENTIAL FITTING FORMULA FOR FAST NEUTRON CROSS SECTIONS**
E. Leo Slaggie [1965] 8 p Presented at the Am. Phys. Soc. Washington Meeting, 26–29 Apr. 1965
(Contract W-31-109-ENG-52)
(Conf-650410-1)

Optical potential fits to carbon and oxygen data were achieved with a resonance formula based on R-matrix theory. The potential scattering was calculated from an optical potential. The procedure permits accurate fits to data that could not be described by an optical model alone. At the same time physical intuition and experience with the optical potential is helpful in selecting parameters. In addition the model has a physical basis related to the need to consider distant level effects in R-matrix theory. An expression is given for the total cross section in terms of phase shifts. A curve showing an example of a resonance-plus-optical fit to a $C^{12}$ elastic neutron cross section, and curves of examples of resonance-plus-optical fits to $C^{12}$ neutron elastic angular distributions are depicted. An optical and resonance formula was also used to fit $O^{16}$ fast neutron elastic cross sections and elastic angular distributions below 2.6 MeV. L.S.

**N65-36531#** Atomic Energy Centre, Dacca (Pakistan). Chemistry Div.
**ELEMENTS OF RADIOACTIVE GROWTH AND DECAY**
Abdur Rahman Jan. 1965 23 p refs
(AECD/CH/2) CFSTI: HC $1.00/MF $0.50

Elementary principles of radioactive growth and decay are reviewed. Focused on are rates of radioactive growth and decay, and radioactive equilibrium. S.C.W.

**N65-36534#** Oak Ridge National Lab., Tenn.
**CHANNEL ANALYSIS OF NEUTRON INDUCED FISSION OF EVEN–EVEN ISOTOPES NEAR THRESHOLD**
R. W. Lamphere [1964] 13 p refs
(Contract W-7405-ENG-26)
(ORNL-P-1082; CONF-650301-9)

Monoenergetic neutrons from either the Li(p,n) or T(p,n) reaction were directed onto a collimated fission counter. The neutrons originate in a tritium gas target. Pictures of the fission counter detector setup and gas target are shown, and the apparatus is described in detail. The target nuclei studied consisted of $^{230}Th$, $^{232}Th$, $^{234}U$, $^{236}U$, $^{238}U$, and $^{240}Pu$. In each case a measure of the angular anisotropy was obtained as a function of neutron energy starting at an energy as low as possible for obtaining significant statistics in a reasonable time, and continuing to energies several hundred kilovolts above the fission threshold. Suitable theoretical expressions were used to ascertain the order in which the various K bands contributed to fission. The levels within the K bands lie very close together, so that they could not be distinguished individually. Predictions from the optical model indicate that strengths of the first two or three levels within any given band will overshadow the effects of all others together in determining the angular anisotropy. Curves showing fission cross sections and fragment anisotropy for the neutron induced fission of the above listed target nuclei are presented. L.S.

**N65-36536#** Oak Ridge National Lab., Tenn. Isotopes Development Center.
**CONCERNING THE EXCITATION OF ARTIFICIALS RADIOACTIVITY IN VARIOUS ELEMENTS [UBER DIE ERREGUNG KUNSTLICHER RADIOAKTIVITAT IN VERSCHIEDENEN ELEMENTEN]**
Lise Meitner May 1965 4 p ref Transl. into ENGLISH from Naturwiss. (Berlin), v. 22, 1934 p 420
(ORNL-TR-627)

Lithium 6 isotope was irradiated with polonium $\alpha$-rays, and the induced activity observed in an average magnetic field photograph of the Wilson cloud chamber is:

$$^{6}_{3}Li + {}^{4}_{2}\alpha = {}^{9}_{5}B + {}^{1}_{0}n \text{ and } {}^{9}_{5}B \rightarrow {}^{9}_{4}Be + e^{+}$$

Since the induced activity was observed several minutes after interrupting the irradiation, it was concluded that the life-time must therefore be several minutes. The energy of the electrons which have to pass through 5 cm of air equivalent for entrance into the chamber is not more than $3 \times 10^5$ volts, thus the neutrons are probably all attributed to $^6Li$ of the Li. From a calculation of the neutron mass, a corresponding process for $^7Li$ is weak. In addition to the positive electrons, very slow negative electrons were sporadically observed, and these electrons are explained by means of the following reaction:

$$^{7}_{3}Li + {}^{4}_{2}\alpha = {}^{10}_{4}Be + {}^{1}_{1}H \text{ and } {}^{10}_{4}Be \rightarrow {}^{10}_{5}B + e^{-}$$

In addition, the artificial radioactivities of Al, Si, P, Cu, and Zn reported by Fermi in the literature were confirmed, and the life times for Al, Si, and P were measured with a Geiger-Muller Counter tube. L.S.

**N65-36537#** Michigan Univ., Ann Arbor.
**THE DECAY OF $W^{187}$**
J. J. Reidy [1965] 12 p refs
(Contract AT(11-1)-1112)
(TID-21828)

The gamma-rays in the decay of $W^{187}$ have been studied using the U-M curved crystal spectrometer and a Ge(Li) spectrometer. Three previously unreported transitions have been observed and the energies of all observed transitions have been determined with the curved crystal spectrometer. Upper limits have been determined for the intensities of possible unobserved gamma-rays in the 160–1200 keV region. The relative merits and complementarity of the curved crystal spectrometer and the Ge(Li) spectrometer are discussed. In addition, data are presented concerning the reflectivity of the curved germanium ($0\bar{2}2$) crystal. Author

**N65-36543#** California Univ., Livermore. Lawrence Radiation Lab.

**CHARACTERISTIC X-RAY PRODUCTION IN THE K-SHELL OF MAGNESIUM AND ALUMINUM BY 25- TO 100-keV PROTONS**

R. D. Worley, D. L. Potter, and J. M. Khan 13 May 1964 11 p refs

(Contract W-7405-ENG-48)

(UCRL-7700)

Characteristic X-rays from the K-shell of magnesium and aluminum were produced by proton bombardment. Thick-target yields were obtained for proton energies between 25 and 100 keV. Using appropriate values for the stopping power and fluorescent yields of 0.021 for magnesium and 0.029 for aluminum, the following range for the ionization cross section of the K-shell was obtained: for magnesium, $2 \times 10^{-25}$–$1.6 \times 10^{-22}$ $cm^2$; and for aluminum, $4.9 \times 10^{-26}$–$5.3 \times 10^{-23}$ $cm^2$. A thin-window, flow-mode proportional counter was used to detect the X-rays. Author

**N65-36544#** California Univ., Livermore. Lawrence Radiation Lab.

**CHERENKOV ELECTROMAGNETIC RADIATION FROM A NUCLEAR DETONATION IN SPACE**

S. A. Colgate and Kane S. Yee 23 Apr. 1964 23 p refs

(Contract W-7405-ENG-48)

(UCRL-7495)

It is predicted that a nuclear detonation above the earth's atmosphere will give rise to an electromagnetic pulse that is in phase with the emitted gamma ray pulse. The maximum electric field at the earth's surface several hundred kilometers from a detonation may reach a limiting breakdown value of 300 V/cm with the electric vector directed opposite to the direction of gamma ray propagation. The origin of the pulse depends upon the Cherenkov-like radiation from the gamma ray produced Compton electron distribution moving across the top of the earth's atmosphere at a phase velocity greater than that of light. The time behavior of the pulse in first order is independent of the thickness of the earth's atmosphere in which the gamma rays are absorbed. Author

**N65-36583#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**THE COMPTON EFFECT ON A MOVING ELECTRON**

V. A. Tumanian 2 Aug. 1965 14 p refs Transl. into ENGLISH from Vopr. Fiz. Elementarnykh Chastits, Akad. Nauk Arm. SSR (Yerevan), 1963 p 464–473

(FTD-MT-65-36; AD-620698)

An interesting peculiarity of the Compton effect on a moving electron is the appearance in the process of scattering of photons harder than the photons being scattered. Due to this, even in the case of scattering of light photons on extremely relativistic electrons, the already scattered photons will possess energies comparable with the energies of the electrons. This peculiarity of Compton scattering can be of practical interest from the point of view of obtaining beams of hard $\gamma$-quanta on high-energy electron accelerators [1-4, 7, 8]. It is important to note that characteristics of such $\gamma$-beams will sharply differ from usual characteristics obtained during deceleration of electrons in matter. Author

**N65-36585#** David Taylor Model Basin, Washington, D. C. Applied Mathematics Lab.

**TET 2: A THERMAL ENERGY TRANSPORT CODE Final Report**

Charles Dawson and Philip E. Battey Jul. 1965 63 p refs

(DTMB-1820; AD-620280)

TET 2 is a FORTRAN language digital computer program designed to produce numerical solutions to the Boltzmann neutron transport equation. TET 2 was designed primarily for thermal neutron problems but it can also do slowing down problems. The derivation of the equations indicates a way in which equations with higher order spatial terms may be derived. Author

**N65-36608#** Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

**DENSITY MEASUREMENT BASED ON GAMMA SCATTERING: BASIS FOR THE DESIGN OF EQUIPMENT APPLICABLE TO SOIL AND OTHER MATERIALS [MEDICION DE DENSIDAD POR RETRODISPERSION GAMMA: BASES PARA EL DISENO DE EQUIPOS APLICABLES A SUELOS Y OTROS MATERIALES]**

Antonio C. Castagnet, Humberto Di Gregorio, Jorge F. Doederer, and Antonio D. Vignolo 1965 40 p refs In SPANISH; ENGLISH summary *Its* Informe No. 137 CFSTI: HC $2.00/MF $0.50

The operation theory of surface density gauges based on gamma scattering and the influence of the various measuring process parameters on signal-density relation was analyzed to establish the general design principles and the intrinsic limitations of these instruments. By varying the source-detector distance of the device, it is possible to determine the transfer function, the optimum source-detector distance, and the calibration curve for any material, using only one sample of known density. A prototype was developed which offers easy calibration for any substance in the density range from one to three grams per cubic centimeter. The measuring probe is connected to a transistorized portable scaler which automatically shows in digital readout the time elapsed to accumulate 10,000 radiation pulses, with an error less than 0.1 second. Density is obtained by inserting said value in the calibration curve. The time required for one density measurement is usually less than 5 minutes. This is comparable to conventional methods. R.N.A.

**N65-36614#** Argentina. Comision Nacional de Energia Atomica, Buenos Aires.

**PREPARATION OF SOURCES OF MOCK $^{131}$I [PREPARACION DE FUENTES SIMULADAS DE $^{131}$I]**

Elma A. A. Tenreyro 1965 29 p refs In SPANISH; ENGLISH summary *Its* Informe No. 147 CFSTI: HC $2.00/MF $0.50

The method of making and calibrating cylindrical standard sources of mock $^{131}$I is described. These sources can be used for measurements with scintillation counters (sodium-iodide cylindrical and well detectors) and well type ionization chambers. They are prepared with a mixture of $^{133}$Ba and $^{137}$Cs and metallic filters, and are useful for $^{131}$I determinations in liquid samples. Author

**N65-36626#** Polish Academy of Sciences, Crackow. Inst. of Nuclear Physics.
**SLOW NEUTRON SCATTERING FUNCTION FOR NON-EQUILIBRIUM SYSTEMS [FUNKCJA ROZPRASZANIA POWOLNYCH NEUTRONOW DLA UKLADOW NIEROWNO-WAGOWYCH]**
Andrzes Fulinski May 1965 33 p refs
(Rept.-409/PS) CFSTI: HC $2.00/MF $0.50

The properties of scattering function for systems not in thermodynamic equilibrium have been studied and those non-equilibrium properties which can be determined by scattering experiment have here been sought. It is found that the scattering of slow neutrons could give the answer to the question if the so-called local equilibrium hypothesis is fulfilled. The non-equilibrium one-particle distribution functions can also be determined from neutron scattering data. Moreover, the formulas describing the scattering in the presence of an external field are obtained, and it is found that an acoustical field applied to the system causes a smoothing down and broadening of the energy distribution of scattered neutrons, which could, perhaps, be of some importance for the cooling down of neutrons. Author

**N65-36631#** Polish Academy of Science, Warsaw. Inst. of Nuclear Research.
**MEASUREMENT OF THE DECAY RATE OF THE SLOW COMPONENT OF LUMINESCENCE IN ORGANIC SCINTILLATORS [IZMERENIYE POSTOYANNYKH VYSVECHIVANIYA MEDLENNOI KOMPONENTY STSINTILLIATSII ORGANICHESKIKH STINTILLIATOROV]**
S. Pshona Feb. 1965 14 p refs In RUSSIAN; ENGLISH summary
(Rept.-604/XIX/D) CFSTI: HC $1.00/MF $0.50

This report describes the method of measurement of the decay rate of the slow component of luminescence in organic scintillators. The results are also given. Author

**N65-36634#** Polish Academy of Sciences, Warsaw. Institute of Nuclear Research.
**SPECTRUM OF BOLTZMANN OPERATOR WITH AN ISOTROPIC THERMALIZATION KERNEL**
Roman Bednarz Mar. 1965 46 p refs
(Rept.-615/IX-A/R) CFSTI: HC $2.00/MF $0.50

This paper contains the proof of the six theorems concerning spectrum of the Boltzmann operator with isotropic thermalization kernel in bounded and convex geometry. The applicability of the spectral theorems to gases, liquids and solids has been discussed. Author

**N65-36636** Polish Academy of Science, Warsaw. Inst. of Nuclear Research.
**FOUNDATIONS OF CLASSICAL THEORY OF ATOM**
Michal Gryzinski Jul. 1965 65 p refs
(Rept.-641/XVIII/PP/) CFSTI: HC $3.00/MF $0.75

It is hypothesized that the ground-state electron is subject to radial oscillations in the Coulomb field of the nucleus. This hypothesis takes into account the magnetic moment of the nucleus and overcomes the obstacle of quantum theory connected with the falling of the electron on the nucleus. A discrete set of asymptotes of oscillatory motion is shown to exist. Results obtained indicate that the radiation process should be associated with changes in the gyroscopic motion of the particle rather than with its acceleration. It is shown that for atoms which have more than one electron, the energy of spin interaction due to oscillation plays a decisive role in formation of electronic shells as well as space orientation of the asymptotes in motion. The conclusion is drawn that wave mechanics may be considered a special case of classical mechanics. M.W.R.

**N65-36637#** Central Lab. for Radiological Protection, Warsaw (Poland).
**EFFECTS OF X-RAY SPECTRUM VARIATIONS ON THE OPTICAL DENSITY IN PHOTOGRAPHIC EMULSION, BY CONSTANT HVL [WPLYW ZMIAN WIDNA PROMIENIOWANIA X NA GESTOSC OPTYCZNA EMULSJI FOTOGRAFICZNEJ PRZY STALEJ PIERWSZEJ WARSTWIE POLCHLONNEJ]**
T. Musialowicz, Z. Referowski, J. Wysopolski, and A. Zdrojewska 1964 21 p refs In POLISH; ENGLISH summary
(CLOR/GUM-35) CFSTI: HC $1.00/MF $0.50

Results of an investigation of the relation between optical density in dosimetric films and X-ray tube potential are reported and discussed. Eight values of constant effective energy in the range 32 to 150 keV were selected for irradiation of films with constant exposure of 300 mR. Below 100 kV the character of density variations was irregular. Above 100 kV the optical density decreased with the increase of effective energy. By constant effective energy 115 keV the optical density for 200 kV was by 15% higher than the corresponding value for 150 kV. Author

**N65-36675#** Nuklearni Institut Joseph Stefan, Ljubljana (Yugoslavia).
**THE REACTION $B^{11}$ (P $\gamma$) $C^{12}$ AT THE 163 KeV RESONANCE AS A SOURCE OF 11,7 AND 16,1 MeV GAMMA-RAYS**
F. Cvelbar, A. Hudoklin, M. Potokar Dec. 1964 5 p refs
(NIJS-R-443) CFSTI: HC $1.00/MF $0.50

The gamma ray spectrum was measured for energies from 16.1 to 11.7 MeV using a telescope pair spectrometer consisting of a lead converter of gamma rays into electron–positron pairs, a thick plastic scintallator, and a coincidence–anticoincidence shield. The pulse-height distribution measured at an angle of 90° is shown. The two peaks are well separated. The error of the experiment was estimated to be ±7% of the 16.1 gamma ray intensity. The corrected value of the thick target intensity ratio of 16.1 to 11.7 MeV gamma rays measured at 90° to the proton beam was found to be 0.037 ±0.003. This value is in excellent agreement with the value obtained previously. This value can be used for the calibration of gamma ray spectrometers by 16.1 MeV gamma rays from the reaction $^{11}B(p, \gamma)C^{12}$ at the 163 keV resonance with an accuracy of about 10%. E.E.B.

**N65-36676#** Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
**PROGRESS REPORT OF THE SANITA SUBSECTION OF THE INFN, 1963–1964 [RELAZIONE SULL'ATTIVITA DELLA SOTTOSEZIONE "SANITA" DELL'INFN NEL 1963-64]**
28 Dec. 1964 28 p refs In ITALIAN; ENGLISH summary
(ISS-64/49) CFSTI: HC $2.00/MF $0.50

This report deals with the activities in the fields of strong, weak, and electromagnetic interactions. Information is presented of the theoretical work and computer activities. Recent achievements of the technical research are described. Author

N65-36683# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica.
**THE SEMINAR AT THE PHYSICS LABORATORY DURING THE PERIOD SEPTEMBER–DECEMBER 1964 [IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE SETTEMBRE–DICEMBRE 1964]**
30 Dec. 1964 62 p In ITALIAN
(ISS-64/50) CFSTI: HC $3.00/MF $0.75

A synopsis of the lectures held at the Physics Laboratory of the Institute Superiore di Sanita during the period between September and December, 1964, is presented. Topics covered include: molecular biophysics; properties of liquid helium-3; the interaction of high energy neutrinos; two-electron excitation levels of noble gas; host-controlled modification of bacteriophage; membrane problems; theoretical techniques in nuclear structure computations; Coulomb scattering for electrons; Polyoma Virus studies; and the conjugation process in .bacteria and streptomycin. Transl. by G.A.L.

N65-36684# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Moscow (USSR). Inst. Teoreticheskoi i Eksperimental'noi Fiziki.
**REALIZATION OF A THREE-DIMENSIONAL UNITARY GROUP BY MEANS OF SPHERICAL FUNCTIONS [REALIZATSIYA TREKHMERNOI UNITARNOI GRUPPY "SFERICHESKIMI FUNKTSIYAMI"]**
M. R. Magomedov and V. V. Sudakov 1964 16 p refs In RUSSIAN; ENGLISH summary *Its* Rept. No. 311
(NP-15202) CFSTI: HC $1.00/MF $0.50

Using the useful parametrization of three-dimension unitary $U_3$-group the representation of this group in the form of "spherical functions" is realized. Supermultiplets are classified in the form of square diagrams on a plane (–S, 2T). Infinitesimal operators in the form of a linear differential operator are introduced and their matrix elements for arbitrary representation are calculated. Author (NSA)

N65-36705# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
**REGULAR EIGENFUNCTIONS OF TIME AND VELOCITY DEPENDENT TRANSPORT EQUATION FOR SLABS**
M. Copic Apr. 1965 18 p refs Presented at the Intern. Symp. on Pulsed Neutron Res., Karlsruhe, West Germany, May 1965
(NIJS-R-449) CFSTI: HC $1.00/MF $0.50

The regular eigensolutions of the transport equation for slabs of finite half-thickness are decomposed into two terms: the eigensolutions of the infinite medium and the transition functions, needed for the proper description of the boundary conditions. The infinite medium solutions are found by the expansion method of Nelkin using the truncated kernel approximation with linearly anisotropic scattering kernel. The boundary transition functions are obtained in the first order approximation from the inhomogeneous integral equation, derived from the integral form of the transport equation. The results for the free proton gas are obtained by the expansion method, using orthonormal polynomials of velocity on the interval $(0, \infty)$ with the Maxwellian velocity distribution as the weight function. The expansion of the neutron density as function of velocity gives better convergence than the usual expansion of neutron flux into Laguerre polynomials of energy or into odd Hermite polynomials of velocity. Author

N65-36732# General Electric Co., Philadelphia, Pa. Missile and Space Div.
**AN EXPERIMENTAL STUDY OF THE DEIONIZATION OF $NO^+$ Scientific Report No. 1**
Marlyn H. Bortner Apr. 1965 32 p refs *Its* Rept.-214–218S1
(Contract AF 19(628)-4153)
(AFCRL-65-391; AD-619252)

An experimental study of the deionization of $NO^+$ has been carried out. The ion were formed by a Penning effect collision between metastable argon atoms and NO molecules. The process was efficient. The deionization process was a combination of the dissociative recombination $NO^+ + e \rightarrow N + O$ and the mutual neutralization $NO^+ + NO_2^- \rightarrow NO + NO_2$, the $NO_2^-$ being formed by a three-step process—Penning dissociation of NO, 3-body formation of $NO_2$ from O and NO, and 3-body attachment to $NO_2$. If all the deionization were due to the $NO^+ + e$ reaction the rate constant found would be $2 \times 10^{-7 \pm 5}$. Reasonable assumptions allow a crude estimate of the $NO^+ + NO_2^-$ rate constant of $2 \times 10^{-8 \pm 1}$. Author (TAB)

# 25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-35777*# National Aeronautics and Space Administration, Washington, D. C.
**DIELECTRIC PROPERTIES OF A HETEROGENEOUS PLASMA [DIELEKTRICHESKIYE SVOYSTVA NEODNORODNOY PLAZMY]**
A. B. Mikhaylovskiy Mar. 1965 30 p refs Transl. into ENGLISH from Yadern. Sintez (USSR), v. 2, no. 3–4, 1962 p 162–176
(NASA-TT-F-9292) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A mathematical expression for the tensor of dielectric permeability of a heterogeneous plasma confined by a constant magnetic field is developed. Effects linked with the drift motions of plasma particles, which are appreciable for waves with a very low phase velocity, are considered in calculating the tensor. In addition the tensor of dielectric permeability is calculated for the case of a plane geometry plasma. A detailed examination is made of the case of low pressure plasma (where $\beta << 1$) in the absence of equilibrium electrical and gravitational fields when a significant role is played only by the effects of Larmor drift. A simpler expression for the dielectric permeability tensor, and an equation for the nonvortical oscillations of arbitrary frequency is derived for this case. Also developed are dispersion equations for Alfven and ion-sonic waves in a heterogeneous plasma, modified by drift movements. These waves prove to be unstable and their oscillation buildup may represent a danger in experiments on plasma confinement. L.S.

N65-35802# Maryland Univ., College Park. Dept. of Physics and Astronomy.
**MEASUREMENT OF THE STARK WIDTHS AND SHIFTS OF NITROGEN ION LINES Scientific Report No. 4**
Richard A. Day (Ph.D. Thesis) May 1965 95 p refs
(Contract AF 19(628)-269)
(AFCRL-65-348; AD-617078)

A hot plasma composed of helium and ionized nitrogen was created by reflecting the shock wave produced in an electromagnetic T-tube. The plasma temperature was measured by monitoring three nitrogen ion lines, whose intensity is a steep function of temperature. The profiles of various lines emitted in the plasma were obtained by scanning a monochromator from shot to shot. The half width of HeI 3889Å

was compared to empirically corrected calculations to obtain the electron density. The half widths of the nitrogen ion lines were measured from the impact broadened profiles; the shifts were obtained by comparing these profiles with unshifted lines from a pulsed capillary discharge. The results indicate agreement between experiment and a recent Stark broadening theory within 20% except for lines originating from the 4f level where Debye screening effects are important. No evidence was found for plasma polarization shift. Author

**N65-35849#** American Science and Engineering, Inc., Cambridge, Mass.
**A NEW METHOD OF PRODUCING HIGH SPEED MOLECULAR BEAMS Final Report, 15 May 1964–14 Mar. 1965**
Lester A. Sodickson, Jack W. Carpenter, and Gilbert Davidson 17 Mar. 1965 65 p refs
(Contract AF 19(628)-4047)
(ASE-933; AFCRL-65-337; AD-617142)

A new method of producing a pulsed, cold beam of high velocity neutral molecules is shown to be feasible. A hollow container filled with a chosen gas is mechanically accelerated to a high velocity in a rifle or light gas gun. The container (called a sabot) is subsequently opened to allow the gas to emerge. The sabot is then slowed or deflected. Velocities up to about 3 km/sec can be achieved with a Super Swift rifle and up to about 10 km/sec with a light gas gun. It appears feasible to produce a pulsed beam at 10 km/sec with an angular divergence of $\pm 2.5°$ and a spread in velocity of $\pm 4\%$. A 5 $\mu$ sec pulse with an instantaneous intensity of the order of $2 \times 10^{23}$ molecules/$cm^2$-sec can be achieved. A beam of $N_2$ crossed with a low velocity beam of CO or $CO_2$ produces vibrationally excited molecules in sufficient quantity to be detected with state-of-the-art techniques. It appears feasible to measure the cross sections for collisional excitation of the vibrational levels of $CO_2$ and CO by $N_2$, and the cross sections for the exchange of vibrational energy between $N_2$ and $CO_2$ or CO. The total cross section, which gives the mean free path, can also be obtained. Author

**N65-35853** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**KINETIC THEORY OF PLASMA WAVE REACTIONS**
V. P. Silin *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 42–54 refs (See N65-35850 24-23)

Equations are derived which describe the nonlinear interaction of oscillations of a plasma with coulomb interaction. The self-action and its related divergence are not considered. As a basis for the development, a statistical description is assumed which uses a correlative function of particles of the plasma. C.T.C.

**N65-35864** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**THEORY OF STABILITY OF INHOMOGENEOUS PLASMA IN MAGNETIC FIELD**
A. M. Fridman *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 151–155 refs (See N65-35850 24-23)

In an isothermal inhomogeneous plasma in a strong magnetic field, the dielectric properties can essentially be changed by the appearance of small space gradients. At this point a branch of oscillations appear, the phase velocity of which coincides with the drift velocity of electrons in the magnetic field at the expense of density gradients. Such waves are considered in this intermediate case. The motion of electrons is described hydrodynamically, and the motion of the ions is described kinetically. C.T.C.

**N65-35865** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**INVESTIGATIONS OF WEAKLY IONIZED HELIUM PLASMA DIFFUSION IN A MAGNETIC FIELD**
S. G. Alikhanov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 156–162 refs (See N65-35850 24-23)

The decay time of a weakly ionized helium plasma in a magnetic field is investigated. Experiments were conducted in a thin tube (d = 1.6 cm) at concentrations of $10^8$ to $10^{10}$ $cm^{-3}$. Results of the experiments differed with the formulas of classical diffusion. The plasma flow on the walls was found to be a reciprocal of the magnetic field strength, and does not depend on the pressure of the neutral gas. The obtained effect agrees with the theory of turbulent diffusion. C.T.C.

**N65-35918#** Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
**RADIATION FROM AN ELECTRIC DIPOLE IN AN INFINITE COLUMN OF WARM PLASMA Scientific Report No. 10**
S. R. Seshadri 1 Jun. 1965 33 p refs
(Contract AF 19(628)-2410)
(AFCRL-65-409; AD-618520)

The radiation characteristics of an axially oriented electric dipole situated at the center of an infinitely long, cylindrical column of warm plasma are investigated. Two types of surface waves are excited along the plasma column and their dispersion and power relations are examined. The radiation pattern in the far-zone and the radiation resistance arising from the space waves are evaluated and their dependence on the source frequency and the radius of the plasma column is discussed. Author

**N65-35936#** Warner and Swasey Co., Flushing, N. Y.
**SPECTROSCOPIC STUDIES OF ARGON AND NITROGEN PLASMAS AT REDUCED PRESSURE. TEMPERATURE DISTRIBUTIONS IN PLASMAJETS AND WALL-STABILIZED ARCS**
Lothar Klein and Harold J. Babrov Wright-Patterson AFB, Ohio. ARL, May 1965 45 p refs
(Contract AF 33(615)-1178)
(ARL-65-92; AD-618193)

Stationary plasmas at reduced pressure (0.02–0.1 atm.) were studied by two different experimental approaches, the plasmajet and the wall-stabilized arc. The nitrogen plasmajet at low pressure is characterized by the appearance of a shock front (Mach disc) and exhibits pressure and temperature gradients. A method based on the atomic Boltzmann plot in absolute intensity units was used to obtain both the pressure and the temperature distribution. A wall-stabilized arc device with wide confining channel proved to be well suited for obtaining a high current (250 A), low pressure (0.1 atm.) argon arc. Core temperatures above 16,000° K were determined and a high degree of ionization observed. The absence of pressure gradients makes the modified wall-stabilized arc a useful tool for research at reduced pressure, but problems of arc stability and symmetry remain to be solved. The wavelengths of several new lines in the argon and nitrogen spectrum were determined, and a strong triplet in the near ultraviolet could be classified as belonging to the transitions $3s\ ^2P - 5p\ ^2D°$ of N I. Author

**N65-35961*#** Rensselaer Polytechnic Inst., Troy, N. Y.
**A MICROWAVE LENS SYSTEM FOR PLASMA DIAGNOSTICS**
R. A. Bitzer and E. H. Holt Washington, NASA, Oct. 1965 14 p refs
(Grant NsG-48)
(NASA-CR-319) CFSTI: HC $1.00/MF $0.50 CSCL 20I

This report discusses the use of lenses to provide plane waves at microwave frequencies for plasma probing. Based on the requirements dictated by an experimental objective of measuring the Faraday rotation of the polarization of an electromagnetic wave in a magnetoplasma, two types of lenses were designed. These were the dielectric lens and the Fresnel half-period zone plate. Tests were conducted on lenses built to these designs and the results obtained were close to the design figures. The superiority of the Fresnel plate over the dielectric lens for plasma diagnostics is demonstrated. The lenses were built for use at K-band frequencies (20 Gc) but improved diagnostics of a plasma can be expected if lenses built to these designs are used at higher frequencies. Author

**N65-35987#** Hughes Aircraft Co., Culver City, Calif. Aerospace Group.

**THE COMPUTATION OF CYLINDRICAL PLASMA RADIATION PROBLEMS Scientific Report No. 1**

J. H. Harris and J. Pachares Jun. 1965 66 p refs

(Contract AF 19(628)-4349)

(P65-79; AFCRL-65-610; AD-620251)

Machine computation of the radiation patterns of antennas in cylindrical plasma environments is considered. General characteristics of the patterns are determined and are related to domains of the cylinder function arguments that enter into the field expressions. In this way, the effects on the computed patterns of various kinds of errors in the cylinder functions for arbitrary plasma properties are established. The manner in which errors enter into computed values for cylinder functions is discussed and methods of avoiding such errors are presented. Tables of Hankel functions of complex argument are included. The expected accuracy of the values in the tables is indicated. Author

**N65-36053** Wisconsin Univ., Madison. Mathematics Research Center.

**AN EXACT ANALYSIS OF LAMINAR MAGNETOHYDRODYNAMIC FLOW IN THE ENTRANCE REGION OF A FLAT DUCT**

R. Manohar *In* Army Res. Office, Durham, N. C. Transl. of the 10th Conf. of Army Mathematicians Jun. 1965 p 39–61 refs

(See N65-36050 24-19)

(Contract DA-11-022-ORD-2059)

A numerical method for obtaining solutions of laminar boundary layer equations for incompressible fluids due to Hartree has been modified here to obtain solutions of the problem of laminar flow of a conducting fluid with constant properties in the entrance region of a semi-infinite flat duct with a transverse magnetic field. The non-linear equations governing the flow in the entrance region are solved numerically for various values of Hartmann numbers and the corresponding velocity profiles, pressure distribution and inlet length are obtained. The same method can be applied to other problems of similar nature. Author

**N65-36193#** Illinois Univ., Urbana. Gaseous Electronics Lab.

**COLLISION FREQUENCY MEASUREMENTS IN OXYGEN AND HELIUM MAGNETOPLASMA AFTERGLOWS Scientific Report No. 2**

G. E. Veatch, J. T. Verdeyen, and J. H. Cahn Jul. 1965 44 p refs

(Contract AF 19(628)-2391)

(AFCRL-65-453; AD-620664)

Collision frequency measurements have been carried out in helium and oxygen at thermal energies. The helium measurements yield a collision probability of 18.7 at 300° K and 1 torr pressure. This corresponds to a cross section for momentum transfer $Q_m$ of $5.29 \times 10^{-16}$ cm.$^2$ at 300° K. The helium collision frequency is directly proportional to approximately the first power of the velocity at 300° K. The oxygen measurements yield a value of $\nu_m(u) = 4.6 \times 10^{-8} N(O_2) u$ where u is the electron energy in electron volts and $N(O_2)$ is the number density of oxygen molecules. The measurements have been carried out by two independent methods. Author

**N65-36241#** Sheffield Univ. (England). Dept. of Applied Mathematics.

**ON THE MAGNETOHYDROSTATIC CAVITY FORMED ROUND A SYSTEM OF LINE CURRENTS IN AN INFINITELY CONDUCTING ATMOSPHERE; A TWO DIMENSIONAL CONFIGURATION Scientific Report No. 4**

Angela M. Downs, R. C. Hewson-Brown, Astrik Deirmendjian, and P. C. Kendall (High Altitude Obs.) 1 May 1965 27 p refs

(Grant AF-EOAR-64-74)

(AFCRL-65-622; AD-620244)

A fluid of infinite electrical conductivity without an internal magnetic field and at uniform pressure is in equilibrium outside an infinitely long irregular cylindrical cavity. The cavity is prevented from collapsing by the magnetic field of a finite number of line currents parallel to the axis of the cylinder. The systematic method of solution of this problem is given in the case when the trace of the cavity is a single, simply connected region. The character of the solution is governed by the number of magnetic neutral points inside the cavity, as well as the nature of the magnetic singularities. The method is illustrated by considering the case of two unequal line currents, and the case of a dipole with equal and oppositely-directed line currents at equal distances on either side. It is shown that the solution can be extended to cases when the external hydrostatic pressure is non-uniform. In illustration, the cases of a line current and a line dipole immersed in an exponential atmosphere are considered. Author

**N65-36312#** Polytechnic Inst. of Brooklyn, Farmingdale, N. Y. Dept. of Aerospace Engineering and Applied Mechanics.

**RADIATION BY A UNIFORMLY ROTATING LINE CHARGE IN A PLASMA Interim Report**

Stanley C. Gianzero, Jr. Jun. 1965 77 p refs

(Contracts Nonr-839(34); Nonr-839(38); ARPA Order 529; Proj. Defender)

(PIBAL-873; AD-619888)

A theoretical investigation is conducted for the radiation produced by a linear distribution of electric charge executing circular motion both inside and outside a cylindrical plasma column. The analysis includes the effects of compressibility and anisotropy of the plasma upon the radiation characteristics of the charge distribution. In the incompressible isotropic case, a dipole resonance phenomenon is exhibited for the first harmonic of the angular frequency of rotation of the charge when the charge moves at non-relativistic velocities. If the charge moves at extremely small velocities, the resonance becomes a singularity. The influence of compressibility upon these radiation characteristics is discussed and is shown to be negligible. In the case of the presence of a magnetic field, i.e. for an anisotropic plasma, the dipole resonance is shifted. Moreover, a multipole resonance is possible for a sufficiently higher order harmonic. Furthermore, in a frequency range just above this multipole resonance, Cerenkov radiation contributes to the existent Bremsstahlung radiation for a single harmonic in the neighborhood of the singularity of the index of refraction. Thereafter, the radiation contributions of the remaining harmonics is negligible. Author

**N65-36316#** Miami Univ., Coral Gables, Fla. Dept. of Physics.
**INJECTION AND TRAPPING OF PLASMA VORTEX STRUCTURES**
Daniel R. Wells Jun. 1965 64 p refs
(Contract AT(40-1)-3293; Grant AF-AFOSR-844-65)
(AD-620545)

Injection of a high density plasma into a magnetic mirror has been accomplished by generating plasma vortex rings under both mirror coils. Observations indicated that the rings move toward the center of the mirror and collide. Trapped magnetic fields in the rings produced a field reversal at the center of the mirror. The collision was followed by an oscillating motion of the ring currents flowing in the highly ionized plasma. Plasma was trapped inside the mirror for times of the order of milliseconds. There was no recycling of the gas in the mirror system. The plasma thermalized and then left through the escape cones and by diffusion to the walls. The ion temperature was of the order of 200 eV. Plasma volume was approximately 1000cc. Confining field was 10kG. Author

**N65-36362#** Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik.
**APPLIED MAGNETOHYDRODYNAMICS. 2: REPORT ON THE THEORY OF LINEAR MHD-INDUCTION GENERATORS [ANGEWANDTE MAGNETOHYDRODYNAMIK. HEFT 2: BEITRAG ZUR THEORIE DER LINEAREN MHD-INDUKTIONSGENERATOREN]**
H. A. Claassen [1965] 17 p refs In GERMAN
(JUL-256-TP) CFSTI: HC $1.00/MF $0.50

The theory of the linear MHD moving field induction generators is considered. The basic equation system for the generator is derived. The equations for the linear MHD induction generator are given. The electrodynamic equation system is solved for the case $\mu = 0$. The impedance of the linear MHD induction generator is derived, and the performance of the Lorentz force and Joule loss are determined. The results are discussed. NSA

**N65-36370#** United Kingdom Atomic Energy Authority, Culham (England).
**PULSED PLASMA GUNS AND INTERACTION BETWEEN PLASMA BLOBS AND MAGNETIC FIELDS**
V. S. Komelkov and B. G. Safronov Nov. 1964 44 p refs Transl. into ENGLISH from Rept. IAE-663, Moscow, I.V. Kurchatov Inst. of Nucl. Energy, 1964 p 1–60
(CLM-TRANS-3) HMSO: 5s 6d

A brief survey is presented of unpublished investigations of plasma guns and of the interaction between plasma blobs and magnetic fields carried out lately in the Soviet Union. Pulsed plasma coaxial guns, coaxial guns with plasma focusing, Bostick type guns, and titanium plasma sources are discussed. Also, the motion of plasma blobs in longitudinal magnetic fields, separation of impurities by a rapidly increasing longitudinal magnetic field, and the interaction of plasma blobs with a transverse magnetic field are included. Pulsed plasma guns are the sources of high density plasma. The plasma blobs generated by these sources have frontal velocities in excess of $10^8$ cm/sec. They carry, however, a multi-component plasma with a high content of impurities originating from the insulators and electrodes. It is essentially the presence of the latter, and of the neutral particles, which renders the plasma obtained from such guns unsuitable for use in certain thermonuclear experiments. Only the frontal part of the blob is ionized and can be used for studying the interaction of the blobs with a magnetic field. Methods of purifying the plasma are proposed. E.E.B.

**N65-36417#** United Kingdom Atomic Energy Authority, Culham (England). Research Group.
**STABILITY OF A PLASMA WITH FINITE $\beta$**
J. Andreoletti 1965 8 p refs Transl. into ENGLISH from C. R. Acad. Sci. (Paris), v. 258, May 1964 p 5183–5186
(CLM-TRANS-4) CFSTI: HC $1.00/MF $0.50

A necessary stability condition is obtained for an arbitrary system without magnetic surface, and a sufficient condition for a system with isotropic pressure and without parallel current. These two conditions tend toward the necessary and sufficient condition for very small and very large $\beta$ respectively. From this, the critical $\beta$ is evaluated in a magnetic well, showing the importance of the transverse depth. Author

**N65-36581#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ACCELERATING SYSTEM WITH DRIFT TUBES AT SUPERSONIC FREQUENCIES**
V. B. Krasovitskiy and V. I. Kurilko 24 Jun. 1965 9 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Kiev), v. 9, no. 10, 1964 p 1134–1136
(FTD-TT-65-652/1+4; AD-620100)

Discussed is a problem of exciting a wave with phase velocity in a cylindrical diffraction grid (diffraction grating) formed by infinitely thin rings of radius a and width 1/2 (1 − period of grating). Excitation is realized by an axially symmetrical incident wave. It is shown, that at $\lambda \simeq 1$ such wave can be excited whereby the filling of the system with a dielectric with $\epsilon \sim 1$ assures the possibility of focusing the field close to the axis of the system. It was also shown, that in such a system is possible propagation of waves, attenuation of which, due to irradiation through the slots of the grating, is small. Author

**N65-36762*#** National Aeronautics and Space Administration, Washington, D. C.
**QUASILINEAR THEORY OF PLASMA OSCILLATIONS [KVAZILINEYNAYA TEORIYA KOLEBANIY PLAZMY]**
A. A. Vedenov, Ye. P. Velikhov, and R. Z. Sagdeyev Oct. 1965 35 p refs Transl. into ENGLISH from Nucl. Fusion (Vienna), suppl., pt. II, 1962 p 465–475 "Plasma Phys." Conf. paper no. CN-10/199, Salzburg, Austria, 1961
(NASA-TT-F-9729) CFSTI: HC $2.00/MF $0.50 CSCL 20I

A method of investigating non-equilibrium processes in systems with collective degrees of freedom is developed. This method allows states of non-equilibrium with strongly excited (suprathermal) oscillations to be studied. As applied to plasma, this method is as follows: when the non-equilibrium processes are examined, allowance is made for the influence of a self-consistent oscillatory field on the particle distribution function. The distribution function appears as a sum of slowly and rapidly varying terms. In the equation for the "slow" distribution function $\mathcal{F}_0$, the quadratic mean effect of the oscillations is taken into consideration. The quasilinear method is used for the study of the problem of the absorption of the energy of finite-amplitude waves in a rarefied plasma. It is shown that, for suprathermal oscillations, damping is considerably less than that obtained from the ordinary linear theory. Author

**N65-36792#** Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
**SHOCK WAVES**
F. Cap and F. Herrnegger 9 Sep. 1964 19 p refs
(Contract AF 61(052)-675)
(SR-13; AD-614053)

Equations for shock waves in a plasma are discussed within the framework of the law of conservation of momentum, energy and mass, and the continuity of both the tangential and normal components of the magnetic field. Shock waves propagating both parallel and obliquely to the magnetic field are considered. A mathematical analysis is also given for the effects on the wave from varying the magnetic field. L.S.

N65-36793# Technische Hochschule Hannover (West Germany). Institut für Theoretische Physik.
**THE ADIABATIC LINEAR STARK EFFECT IN A PLASMA Technical Note No. 3**
K. H. Wilke, K. Hunger, and R. W. Larentz 1 Dec. 1964 17 p refs
(Contract AF 61(052)-161)
(AFCRL-65-192; AD-614283)

The electrical microfield in a plasma changes rapidly in space and time. For this reason the linear Stark effect of hydrogen spectral lines emitted from a plasma cannot be treated by a pure static theory. Corrections to this picture arguing with the "Weisskopf-Radius" are specifying whether the field of a nearby passing charge can be looked upon as acting adiabatically on the atom or not. A more rigorous treatment has to consider the simultaneous action of the long range Coulomb fields of many particles. Only the low frequency part of this composed field leads to adiabatic energy shifts. On obtaining an expression for the mean square low frequency field some Balmer line profiles are computed as far as the adiabatic Stark effect is concerned. On account of some new results on the probability distribution of the microfield a Gaussian distribution has to be used for the adiabatic shift of a single energy term. The resulting profiles are compared with those of the static "Holtsmark-Theory." Author

N65-36795# University Coll., Cardiff (Wales).
**RADIATIVE CASCADE THEORY Scientific Report No. 4**
P. Lal and P. T. Landsberg 1 Jan. 1965 25 p refs
(Contract AF 61(052)-664)
(AFCRL-65-182; AD-614621)

A theory is developed for the radiative cascade between a continuum and the states of hydrogen-like ions. It is assumed that a steady state can be maintained by pumping electrons from the ground states into the continuum. The various electronic transitions which occur in such a situation are assumed to be radiative. This problem does not seem to have been treated explicitly in solid state physics (when the continuum can be conduction band), except for the formal considerations by Niagae (1963). It has, however, received attention in astrophysics (Seaton, 1959; Bates, et. al., 1962). The present paper is written in such a way that it can be used also in astrophysics. TAB

N65-36808# Princeton Univ., N. J. Plasma Physics Lab.
**PLASMA COLUMN END EFFECTS**
N. Rynn Sep. 1965 43 p refs
(Contract AT(30-1)-1238)
(MATT-375)

The end effects, or sheaths, of the plasma column of the Q-1 device are analyzed. The analysis utilizes an adaptation of the methods that have been used by Auer and McIntyre to predict the potential distributions in thermionic converters. Poisson's equation is solved under the assumptions of no collisions, no trapping, and a Maxwellian distribution of particles at the emitting boundaries and in the plasma. The model used requires the presence of a potential well in front of each plate. Although simpler than the actual situation with collisions and trapping, the model nevertheless seems to predict, qualitatively, the observed asymmetries in the volt-ampere characteristics, the observed density variations with current flow, and the observed variations with operating conditions. The analysis also indicates a possible explanation for certain of the observed instabilities. Author

N65-36809# Princeton Univ., N. J. Plasma Physics Lab.
**PLASMA CONFINEMENT IN LOW-DENSITY C STELLARATOR DISCHARGES**
W. Stodiek, D. J. Grove, and J. O. Kessler Sep. 1965 24 p refs
(Contract AT(30-1)-1238)
(MATT-372)

Theoretical work has suggested that anomalously high plasma loss rates (pumpout) may be due to ohmic heating currents. Previous experiments however showed that pumpout persists even when the current (normally required to prevent cooling and recombination) are much below the critical values for ion wave instabilities. The present paper reports experiments on the C stellarator which extend the measurements to zero ohmic heating currents. They were performed at low initial pressures ($2–3 \times 10^{-6}$ torr) of hydrogen, at low electron densities of $5 \times 10^{9}$ to $2 \times 10^{11}$ cm$^{-3}$ and at electron temperatures of 1 to 3 eV. The confining field was usually 12.3 kG; a few measurements were made at 35 kG. A rotational transform of 0.75 $\pi$ was provided by $l = 2$ and $l = 3$ helical windings. In these low-density, low-temperature experiments an anomalous loss rate exists in the C stellarator for four operating conditions: (1) ohmic heating, (2) electron cyclotron resonance heating, (3) resistive microwave heating, and (4) no heating at all. We conclude that neither the presence of an axial current of small magnitude nor density variations in the range $5 \times 10^{9} < n_e < 2 \times 10^{11}$ cm$^{-3}$ seem to affect the transport time constant $\tau_p$ for plasma loss across the magnetic confining field. Author

N65-36813# Princeton Univ., N. J. Plasma Physics Lab.
**ON THE INTERACTION OF AN ION BEAM WITH A PLASMA**
L. Enriques Sep. 1965 23 p refs
(Contract AT(30-1)-1238)
(MATT-366)

The marginal stability condition for the excitation of ion waves, in an uniform plasma, by means of an ion beam of arbitrary density, is found as a function of the beam velocity and temperature. Preliminary results of a related experiment performed in the Q-3-T cesium plasma device are also reported. Author

N65-36825# Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
**VARIATIONAL METHODS FOR THE SOLUTION OF TWO-DIMENSIONAL STEADY MAGNETOGASDYNAMIC FLOWS**
F. Cap and G. Mueller 23 Sep. 1964 10 p refs
(Contract AF 61(052)-675)
(SR-19; AD-613624)

It was shown that a two-dimensional steady magnetogasdynamic potential flow can be described by a variational problem. This problem was obtained by introducing polar coordinates and was solved by the Ritz method. The method was shown by the flow past a cylinder; since the problem was symmetrical in $\psi$, the first sum was taken into account. R.W.H.

N65-36826# Cornell Univ., Ithaca, N. Y.
**THE TRANSIENT HYDROMAGNETIC FLOW PAST AN AIRFOIL FOR AN ALIGNED MAGNETIC FIELD**

S. Leibovich and G. S. S. Ludford May 1965 27 p refs Repr. from J. de Mecanique (France), v. 4, no. 1, Mar. 1965
(Contract Nonr-401(06))
(TR-8; AD-617225)

The steady flow of a perfectly conducting inviscid liquid past a thin symmetric airfoil in the presence of a uniform magnetic field is discussed, and Stewartson's transient problem, the determination of the ultimate steady flow due to setting the airfoil into motion impulsively along the magnetic field, is re-examined. The complete development of the flow after the impulsive start was presented previously; in particular, slightly modified Alfven waves travel out from the airfoil along the magnetic lines bringing the fluid to rest relative to the slug flow. Channeled Alfven waves are discussed, and it is concluded that features predicted by both Stewartson and Sears–Resler appear in the steady limit of the transient problem. The exterior flow pattern, following the magnetic lines outside the current sheets, is a Sears–Resler potential flow over a portion of the profile at which there are current sheets. The interior flow stemming from the remainder of the profile is a Stewartson slug flow. E.E.B.

**N65-36852#** Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
**VORTEX THEOREMS AND POTENTIAL FLOW IN MGD**
F. Cap and H. Friedel 25 Sep. 1964 7 p refs
(Contract AF 61(052)-675)
(SR-14; AD-613623)

Studied frequently was the disappearance of a vortex vector in magnetogasdynamics. This condition was necessary for the existence of a velocity potential and for a potential flow. Results were derived on the basis of general MGD vortex theorems with respect to F. Cap's potential equation. It was shown that the studies were confined to an ideal plasma (i.e. infinite electrical conductivity, vanishing internal friction, and heat conductivity). R.W.H.

**N65-36854#** Innsbruck Univ. (Austria). Inst. for Theoretical Physics.
**MAGNETOGASDYNAMIC WAVES OF SMALL AMPLITUDE**
F. Cap and Helmut Friedel 14 Jul. 1964 15 p refs
(Contract AF 61(052)-675)
(SR-12; AD-613621)

Data on the propagation of magnetogasdynamic (MGD) waves with small amplitude were studied, and the basic MGD equations were considered. Two methods for solving these equations are presented. In the first, the calculations are based on linearized equations, with the propagation of plane waves studied in a medium at rest. In the second method, perturbations of a more general type are examined, and the theory of characteristics is applied. It is shown that both methods yield consistent results, proving the existence of fast and slow magnetoacoustic waves. M.G.J.

# 26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

**N65-35820#** Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
**FAILURE MECHANISMS IN SILICON SEMICONDUCTORS**
**Final Report, 1 Mar. 1963–31 Aug. 1964**
W. Schroen and W. W. Hooper Griffiss AFB, N. Y., RADC, Mar. 1965 314 p refs
(Contract AF 30(602)-3016)
(RADC-TR-64-524; AD-615312)

Thermal instability in silicon power transistors, the related phenomena of hot spots and second breakdown, and the theory of the thermal instability problem are presented. A rather extensive investigation of the damage which occurs in silicon power transistors as a result of hot spots and second breakdown is included, and finally, special transistor structures are studied which serve to confirm earlier theories on thermal instability and shed new light on possible methods by which the failure mode of second breakdown can be minimized. The surface properties of oxide covered silicon and silicon p–n junctions, in particular, the problem of charge motion on the outer surface of the oxide covering silicon and silicon p–n junction is studied with relevance to the current-voltage characteristics of reverse biased silicon p–n junctions. These investigations are directed at a better understanding of the physics of failures which occur in oxide covered p–n junction devices. Author

**N65-35821#** Illinois Univ., Urbana. Dept. of Electrical Engineering.
**JUNCTION EFFECTS IN COMPOUND SEMICONDUCTORS**
**Scientific Report No. 1**
Nick Holonyak, Jr., M. D. Sirkis, C. J. Nuese, and C. M. Wolfe Dec. 1964 27 p refs
(Contract AF 19(628)-4337)
(AFCRL-65-93; AD-615435)

Progress which has been achieved in the synthesis of laser-quality $Ga(As_{1-x}P_x)$ is reviewed. The method of synthesis and the structural, defect, and dislocation properties of the material are discussed. The general procedure for evaluation $Ga(As_{1-x}P_x)$ in laser diodes is reviewed. Laser junctions in $Ga(As_{1-x}P_x)$ with $x \approx 0.33$ and threshold currents near 3000 $A/cm^2$ at 77° K are described. Apparatus for and experiments involving electron beam bombardment of III–V and II–VI semiconductor samples are described. The possibility of using this method to study recombination radiation in semiconductors in which currently junctions cannot be fabricated is discussed. An electron beam bombardment experiment which shows unambiguously that recombination radiation in $Ga(As_{1-x}P_x)$ junctions originates on the p-type side of the junction is described. Author

**N65-35832*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EXPERIMENTAL STUDY OF TRANSIENT EFFECTS IN DIELECTRIC MATERIALS CAUSED BY ELECTRON IRRADIATION**
George M. Storti, Donald H. Phillips, and Clifford S. Frank Washington, NASA, Oct. 1965 59 p refs
(NASA-TN-D-3032) CFSTI: HC $3.00/MF $0.50 CSCL 20L

Voltage pulses in capacitors and insulated wires during low-energy electron irradiation were studied. Various dielectric materials (polyethylene terephthalate, polytetrafluoroethylene, polystyrene, ceramic, polypyromellitimide, regenerated cellulose, polyvinyl alcohol, a copolymer of polyvinyl chloride and polyvinylidene chloride, mica paper, and silicone-impregnated mica paper) were tested over a range of incident electron kinetic energies, temperatures, and dose rates. Some dielectrics were found to have relatively few voltage pulses occurring as a result of irradiation, whereas others pulsed rapidly and with large amplitudes. The number of pulses was found to vary with the incident electron kinetic energy. Because of the thinness of most of the samples tested, the greatest number of pulses was obtained at the lower energies (30 to 100 keV), and, in all

cases, the number of pulses decreased markedly as the electron energy was increased. Temperature also had a profound effect on the number of pulses. Irradiation at low temperatures resulted in a greater number of pulses. Dose-rate effects on the number of pulses were significant except at the lowest temperatures at which the tests were conducted. Author

**N65-35893#** Massachusetts Inst. of Tech., Cambridge.
**SOLID-STATE AND MOLECULAR THEORY GROUP Quarterly Progress Report**
15 Jan. 1965 68 p refs
(Contracts Nonr-1841(34); AF 19(628)-356; Grants NSF GP-3241; NSF G-24908)
(QPR-55; AD-610491)

CONTENTS:

1. SURVEY J. C. Slater p 1–3
2. CONSTANT ENERGY SURFACE FOR GALLIUM J. H Wood p 9–25 (See N65-35894 23-26)
3. ENERGY BANDS IN DIAMOND E. R. Keown and J. H. Wood p 26–44 refs (See N65-35895 23-26)
4. ON THE RADIATION PROBLEM AND IMPURITY CONTRIBUTION TO OPTICAL ABSORPTION IN ALKALI HALIDES L. Gunther p 45–53 refs (See N65-35896 23-26)
5. ON THE OBSERVED FREQUENCY RATIOS OF H U-CENTERS AND D U-CENTERS L. Gunther p 54–57 refs (See N65-35897 23-26)
6. 3D ION COVALENCY: $KNiF_3$ D. E. Ellis p 58–63 refs (See N65-35898 23-26)

**N65-35894** Massachusetts Inst. of Tech., Cambridge.
**CONSTANT ENERGY SURFACE FOR GALLIUM**
J. H. Wood *In its* Solid-State Mol. Theory Group 15 Jan. 1965 p 9–25 (See N65-35893 24-26)

Figures are presented to show intersections of surfaces of constant Fermi energy with a number of planes for gallium. Fermi energy was determined from an Augmented Plane Wave (APW) band calculation by filling up states to an equivalent of six full bands. The planes are intersections through the first Brillouin zone and fall into three sets; each set consists of planes parallel to a particular coordinate plane. Figures are plotted in k-space as distinct from reciprocal space. M.W.R.

**N65-35895** Massachusetts Inst. of Tech., Cambridge.
**ENERGY BANDS IN DIAMOND**
E. R. Keown and J. H. Wood *In its* Solid-State Mol. Theory Group 15 Jan. 1965 p 26–44 refs (See N65-35893 23-26)

The Augmented Plane Wave Method for calculating energy bands is found to be satisfactory for the case of a covalent crystal where the assumption of a "muffin-tin" potential is probably the least tenable. A modified Slater Representation Theory is demonstrated as practical to reduce plane wave representations; and results obtained agree with those obtained in orthogonal plane wave calculations for diamond. Calculations also indicate that the use of constant potential between the spheres as a disposable parameter may be valuable in cases where there is considerable variation in crystal potential between the spheres. These calculations also show a gap in the conduction states of the diamond crystal. One-electron crystal potentials are listed in Rydberg units. Calculations tabulated for the 20 symmetry points of the first Brillouin zone give a mesh of 256 points. Energy eigenvalues are classified according to symmetry and are also presented in increasing order. Energy bands for diamond are graphed for the principal and subsidiary symmetry directions; and a density-of-states curve is compiled. M.W.R.

**N65-35896** Massachusetts Inst. of Tech., Cambridge.
**ON THE RADIATION PROBLEM AND IMPURITY CONTRIBUTION TO OPTICAL ABSORPTION IN ALKALI HALIDES**
Leon Gunther *In its* Solid-State Mol. Theory Group 15 Jan. 1965 p 45–53 refs (See N65-35893 24-26)

Lattice vibration in ionic crystals and corrected results relating to thermal conductivity and optical absorption are discussed in a paper dealing with the radiation problem and impurity contribution to optical absorption in alkali halides. A modified dynamical matrix is used to calculate the impurity contribution to the thermal conductivity lifetime, and a series of equations is developed. A total Hamiltonian is obtained for certain impurity modes in the presence of an external field yielding a macroscopic field. Obtained are three types of nonzero $m_\alpha(k)$: those due to local modes, those due to transverse optical modes at $k = 0$, and those referred to as a background contribution due to inband mode impurity scattering. A damping term due to the finite lifetime of the modes is included, and the absorption coefficient is obtained. Results indicate that the length characterizing the localization of NaI: $Li^+$ local mode is less than a lattice spacing. M.W.R.

**N65-35897#** Massachusetts Inst. of Tech., Cambridge.
**ON THE OBSERVED FREQUENCY RATIOS OF H U-CENTERS AND D U-CENTERS**
Leon Gunther *In its* Solid-State Mol. Theory Group 15 Jan. 1965 p 54–57 refs (See N65-35893 23-26)

Absorption frequency in $H^-$ or $D^-$ substitution in U-centers of alkali halides is shown to be inversely proportional to the square root of the impurity mass even when force constant changes are taken into account. The experimentally determined absorption frequency is shown to provide a good estimate of the repulsive force constant between the impurity mass and its neighbors. An equation for finding absorption frequency is derived from Green's function theory; the validity of the harmonic approximation is checked and changes in the effective charge and electronic polarizability are considered. M.W.R.

**N65-35898** Massachusetts Inst. of Tech., Cambridge.
**3d ION COVALENCY: $KNiF_3$**
D. E. Ellis *In its* Solid-State Mol. Theory Group 15 Jan. 1965 p 58–63 refs (See N65-35893 24-26)

An M–O approach for the ionic Hamiltonian approximation is discussed in relation to the ground and first excited states of the $Ni^{2+}(F^-)_6$ octahedral complex in $KNiF_3$. Matrix elements have been computed to include multi-center contributions due to ligand–ligand overlap, and overlap density contributions to integrals and to molecular orbital normalization are found to have a significant effect on the matrix elements. Considerable ligand s-p hybridization is exhibited within the bonding orbitals. Better experimental agreement has been shown with both the crystal field splitting and hyperfine parameters. Sensitivity of matrix elements to overlap densities indicates that the ionic Hamiltonian is not suitable for a self consistent iteration, and the complete molecular Hamiltonian is considered. It is reported that the use of three and four-center integrals is reaching a practical level. Covalent eigenvectors and mixing parameters are tabulated for the ground and excited states, and contributions to the crystal field splitting 10 Dq are given. Calculated fractional spin densities at the $F^-$ nucleus are also given. M.W.R.

**N65-35934#** Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
**RESEARCH AND DEVELOPMENT FOR SEMICONDUCTORS SURFACE CONTROL AND STABILIZATION Final Report, Nov. 1963–Feb. 1965**

Ki Dong Kang 14 Mar. 1965 114 p refs
(Contract AF 19(628)-3808)
(AFCRL-65-361; AD-618736)

Studies were made of certain surface effects on silicon device parameters. These studies can be categorized as falling in three broad areas: the oxide-ambient gas interface, the oxide-semiconductor interface, and the oxide itself. Topics included in this investigation were: gross chemical contamination of oxide surfaces, oxide defects generated during manufacture of devices, interface distributions and gettering of metallics, modulation of surface electron density in MOS devices, and gamma-ray irradiation effects on conventional and MOS silicon devices. Also explained are the surface phenomena occurring in all these areas which might be consequential in the control and stabilization of semiconductor surfaces. Author

**N65-35949#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**CERTAIN PROBLEMS OF THE PHYSICS OF SEMICONDUCTORS**
B. M. Vul 28 Jul. 1965 11 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 8, 1964 p 65–70
(FTD-TT-65-537/1+2+4; AD-619320)

The electrical structure of semiconductors is discussed. Electron paramagnetic resonance is treated in semiconductors. The problem of low temperature flash-over in semiconductors is considered. TAB

**N65-35986#** Hyletronics Corp., Burlington, Mass.
**MICROWAVE STUDIES OF SEMICONDUCTING DIAMONDS Final Report, 16 Oct. 1963–15 Nov. 1964**
Marshall H. Sirvetz 14 Jun. 1965 59 p refs
(Contract AF 19(628)-3856)
(AFCRL-65-529; AD-620085)

Microwave measurement techniques have been applied to the study of semiconducting diamonds. An initially non-conducting diamond treated with boron under high temperature–high pressure conditions was shown to have semiconducting properties. By means of successive experiments in which portions of the specimen were removed by cleaving and polishing, an estimate of the thickness of the semiconducting layer (depth of diffusion) was obtained. The conductivity and activation energy of the semiconducting layer were deduced from the data. In many similar doping experiments, negative results were obtained in the sense that the only observed microwave loss could be associated with surface deterioration (formation of graphite or boron carbide). The perturbation formulas for lossy semiconducting specimens were extended and applied to the analysis of loss-versus-temperature data of natural (IIb) semiconducting diamonds. Author

**N65-35988#** Ecole Normale Superieure, Paris (France). Laboratoire de Physique.
**OPTICAL PROPERTIES OF DEGENERATE SILICON Technical Note No. 2**
M. Balkanski and J. M. Besson [1965] 16 p
(Contract AF 61(052)-789)
(AFCRL-65-511; AD-619581)

The optical properties of degenerate silicon were investigated. Reflectivity measurements were taken at all temperatures using an infrared vacuum spectrometer. Silicon crystals were aluminized on one-half of the working area which minimized the errors due to differences in surface state and planeity between the sample and the reference mirror. For low temperature measurements, a thin polyethylene sheet protected the sample surface against oil deposits. The samples were in contact with the coolant through an electrolytic copper holder and their temperature was measured directly with a thermocouple. The Kramers–Kronig inversion was applied to the experimental data to obtain N and K. Then the classical Drude-Zener model was used to give an estimate of the mobility, effective mass, and relaxation time of the carriers. TAB

**N65-36211#** Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
**A PROPOSAL TO INVESTIGATE THE PHYSICAL PROPERTIES OF SAMPLES UNDER VERY HIGH PRESSURES BY TIME-OF-FLIGHT NEUTRON DIFFRACTION METHODS**
R. M. Brugger Aug. 1965 21 p refs
(Contract AT(10-1)-205)
(IDO-17106) CFSTI: $1.00

It is proposed to measure the properties of greatly compressed solids under very high pressures by measuring the diffraction of neutrons from powdered samples under very high pressures. Neutron diffraction by the time-of-flight method will be developed because this method compared to the customary variable angle system appears to be less restricted by the limitations placed on the diffracting system by the high pressure devices. Using existing technology, a time-of-flight system has been designed that has ample intensity, has a resolution improvement of X5 over existing diffractometers, and is compatible with the high pressure devices. Modifications of existing high pressure systems are proposed that use Al, $Al_2O_3$, Mg, MgO, or Be as a pressure cell or as a gasket material to allow passage of the neutrons. Pressure systems of increasing complexity are proposed that should be capable of obtaining pressures of 10 to 100 kbars with pressure gradients of less than three percent. Temperatures up to 1000°C will also be available in these presses. Author

**N65-36265#** Oklahoma State Univ. Research Foundation, Stillwater.
**PHOTOELECTRIC EMISSION AND SURFACE STATES OF SEMICONDUCTING DIAMONDS Final Report, 15 Jan. 1963–15 May 1965**
William J. Leivo, M. D. Bell, Whua Fu Wei, and Clyde Northrup 28 May 1965 117 p refs
(Contract AF 19(628)-2385)
(AFCRL-65-489; AD-619724)

Photoelectric emission from natural semiconducting diamonds was observed with light of wavelengths above 1050Å obtained from a carbon arc operated in nitrogen gas at a low pressure. The light from the arc was filtered through various crystal filters. Saturation photoemission currents were measured with a vibrating reed electrometer when each filter was used. The nature of various types of electrical contacts to semiconducting diamonds was investigated. The contacts included silver paint, low melting point solders, evaporated metal contacts, contacts formed using titanium hydride and contacts formed by thermal compression. Surface states in diamond were investigated by analysis of the photovoltage at a metal to diamond contact. The photovoltaic spectral response was examined from 2$\mu$ to 185 m$\mu$ and correlated with the photoconductivity and optical absorption. Author

**N65-36267#** IIT Research Inst., Chicago, Ill.
**INVESTIGATION OF NARROW LINE ABSORPTIONS IN SINGLE CRYSTAL CALCITE Final Report, Feb. 1964–Feb. 1965**
S. A. Marshall Griffiss AFB, N. Y., RADC, Jul. 1965 63 p refs
(Contract AF 30(602)-3321)
(IITRI-A6074; RADC-TR-65-159; AD-619963)

Single crystals of calcite exposed to γ-rays and X-rays were studied by electron spin resonance and optical absorption techniques. A number of paramagnetic defect centers are produced by these radiations some of which are stable at very low temperatures while others are stable up to room temperature. Two paramagnetic defect centers have been tentatively identified as the OH and $CO_3$ radicals and extensive data has been obtained on two other centers. Optical absorption measurements were taken on γ and neutron irradiated calcite. The spectrum of the γ-irradiated specimen includes an intense anisotropic absorption band at about 2900 Å which is due to the $CO_3^-$ molecule-ion. An intense anisotropic absorption band at approximately 2850 Å was observed in the neutron irradiated specimen which is assigned to the $CO_2^-$ molecule-ion. Finally, the superhyperfine interaction between the divalent manganese ion and the 1.1% naturally abundant $C^{13}$ nuclei associated with the six carbonate groups is reported. The angular dependence of the superhyperfine splitting in a plane perpendicular to the crystal (111) direction is discussed. Author

N65-36274# Clevite Corp., Cleveland, Ohio. Electronic Research Div.
**RESEARCH ON II-VI COMPOUND SEMICONDUCTORS Final Technical Report, 1 Jan. 1962–31 Jan. 1965**
Labo R. Shiozawa and Jacob M. Jost Wright-Patterson AFB, Ohio, ARL, May 1965 213 p refs
(Contract AF 33(657)-7399)
(ARL-65-98; AD-620297)

This report summarizes three years of research on material purification and crystal growth of CdS, CdSe, ZnTe, and CdSe–ZnSe and on the measurement of the fundamental properties of the crystals. In addition, a preliminary investigation has been made into the luminescent phenomena in CdS. Author

N65-36309# Westinghouse Electric Corp., Elmira, N. Y. Electronic Tube Div.
**APPLICATION OF LIGHT AND IMAGE INTENSIFICATION Monthly Technical Engineering Report, 1–30 Jun. 1965**
D. C. Fowlis, R. D. Harder, and Z. Szepesi 13 Jul. 1965 11 p refs
(Contract N61339-1440)
(MTER-24; AD-620318)

Series of experiments with sintered CdSe PC sandwich cells have been continued with the goal to eliminate the spotty structure, due to inhomogeneities and the formation of cadmium oxychloride during the sintering process. Small image intensifier panels have been fabricated using the test cells of above experiments. It was found that PC layers sintered mostly in nitrogen show much better image quality than those sintered in air atmosphere. Author

N65-36369# United Kingdom Atomic Energy Authority, Harwell (England).
**SEMICONDUCTOR DETECTORS FOR γ-RAY SPECTROSCOPY**
P. E. Gibbons and R. B. Owen Jul. 1965 15 p refs
(AERE-M-1602) HMSO: 3s

The use of silicon and germanium semiconductor detectors for gamma ray spectroscopy is discussed, and the construction of a germanium detector with both zone-levelled and pulled single crystal material with p-type resistivities over the 10 cm to 40 cm range is described. Carrier velocities for germanium at liquid nitrogen temperature, and gamma-spectra obtained by using a cooled field effect transistor as the input stage to a charge sensitive pulse amplifier are graphically depicted. In addition, a table listing the relevant properties of some promising heavy element semiconductors (including InSb, InAs, InP, GaSb, AlSb, and CdTe) are presented, along with a discussion of each type of crystal. L.S.

N65-36394*# Rochester Univ., N. Y. Inst. of Optics.
**STRUCTURE IN THE OPTICAL ABSORPTION EDGE OF AMORPHOUS SELENIUM Technical Note No. 8**
Dean Brinton Mc Kenney (M.S. Thesis) Aug. 1965 75 p refs
(Contract NASw-107)
(NASA-CR-67499) CFSTI: HC $3.00/MF $0.75 CSCL 20L

The absorption spectrum near the band edge of amorphous selenium was measured at temperatures between 295° K and 20° K on evaporated samples with and without substrates. A large difference between the two types of samples was noted especially at low temperatures. Structure in the absorption spectrum of unsupported samples similar to that observed in other semiconductors was analyzed and it is suggested that this structure is caused by indirect transitions between the valence band and the conduction band and by the formation of indirect excitons. The energy of the phonon assisting in the indirect transitions was found to be 0.023 eV. The binding energy of the exciton was 0.076 eV, and the energy of the indirect band gap was 1.717 eV at room temperature, increasing nearly with temperature by $7.4 \times 10^{-4}$ eV/° K over a wide range of temperatures. Author

N65-36424 North American Aviation Science Center, Thousand Oaks, Calif.
**MOSSBAUER EFFECT DATA INDEX, ISSUE 3**
A. H. Muir, Jr., K. J. Ando, and H. M. Coogan, comp. Jul. 1965 249 p refs
(SCTR-65-2) Available from N. Am. Aviation Sci. Center

An organized up-to-date index to published research results relating to the Mössbauer effect is presented. Although the primary emphasis is on experimental results, bibliography sections of theoretical, review, and instrumentation publications are included. Complete nuclear data and Mössbauer properties summary sheets are included for each isotope and transition. The organization of the index to the experimental data involves three principal considerations: (1) nuclear transition; (2) source material or host; and (3) absorber (or scatterer) material or host. R.R.D.

N65-36504# California Univ., Berkeley. Lawrence Radiation Lab.
**TOTAL SPIN-EXCHANGE CROSS SECTIONS FOR ALKALI ATOMS FROM OPTICAL PUMPING EXPERIMENTS**
Hyatt Mc Donald Gibbs (Ph.D. Thesis) 12 Mar. 1965 110 p refs
(Contract W-7405-ENG-48)
(UCRL-16034)

The importance of the nuclear pins in the analysis of alkali spin-exchange experiments employing Zeeman optical pumping by circularly polarized light and performed in low magnetic fields is demonstrated. The signal for general nuclear spin is found for the Franzen-type transient experiment and for the Dehmelt-type steady-state experiment in the limit of low light intensity. The results are quite sensitive to the process assumed for the relaxation of the ground-state populations. The solutions are given for a general process in which randomly oriented disorientation fields interact with the spins of the alkali atom only through the electron spin. The steady-state signal expression includes the effects of self spin exchange and partial disorientation in the excited state. Only

the diagonal elements of the density matrix are included. A hyperfine optical pumping experiment employing the Franzen transient method is described in detail. It was applied to the most precise determination to date of the total spin-exchange cross sections $\sigma_{^{87}Rb-^{87}Rb} = (2.03 \pm 0.20) \times 10^{-14}$ cm$^2$ and $\sigma_{^{87}Rb-^{133}Cs} = (2.18 \pm 0.31) \times 10^{-14}$ cm$^2$. A scanning Fabry-Perot interferometer is used in estimating the densities of the alkali vapors. Problems introduced by the Fabry-Perot and overlooked in the past are discussed.
Author (NSA)

**N65-36522#** Pittsburgh Univ., Pa. Dept. of Chemistry.
**THERMAL, STRUCTURAL AND MAGNETIC STUDIES OF METALS AND INTERMETALLIC COMPOUNDS Annual Report, May 15, 1964–May 15, 1965**
W. R. Wallace and R. S. Craig [1965] 60 p refs
(Contract AT(30-1)-3454)
(NYO-3454-1)

Results of measurements of the electronic specific heat at 1.4 to 4.2° K and the magnetic susceptibilities and other magnetic properties at 1.4 to 300° K of a large number of intermetallic compounds and alloys are reported.
NSA

**N65-36574#** Grumman Aircraft Engineering Corp., Bethpage, N. Y.
**A STUDY OF SINGLE CRYSTAL GROWTH**
C. H. Li Feb. 1965 45 p refs
(RM-265)

A technique that uses simple normal freezing, but with concentration-dependent segregation coefficients, is employed to study single crystal growths from melts. It is first shown that only in normal freezing is the maximum amount of impurity atoms rejected by the growing crystal. Faster cooling rates result in additional quenched-in impurities whereas slower cooling rates cause back diffusion of impurities into the solid crystal. Additional impurity centers may induce in the crystal extra defects such as precipitates, strains, dislocations, and vacancies. Normal freezing with constant segregation coefficients is a very useful technique to treat dilute solutions but loses accuracy as the solution concentration increases. The famous lever rule may be used to treat melt solutions in any concentration range, but often underestimates the amount of rejected impurity for dilute solutions and slightly overestimates the same amount for solutions near the eutectic compositions.
Author

**N65-36652#** Air Force Systems Command, Wright-Patterson AFP, Ohio. Foreign Technology Div.
**DETERMINATION OF THICKNESS, HEAT CAPACITY AND THERMAL CONDUCTIVITY OF MINIATURE THIN FILMS**
L. S. Kremenchugskiy and V. S. Lysenko et al 1 Jul. 1965 13 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 7, no. 2, 1964 p 3-9
(FTD-TT-65-619/1+2+4; AD-617675)

A new method is presented for the determination of thickness, heat capacity and thermal conductivity of miniature thin films based on their frequency characteristics. Application of the method is illustrated with thin nickel films.
Author

**N65-36701#** Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum.
**OSCILLATING STATE OF AN IMPURE ATOM IN THE CUBIC SURFACE CENTERED LATTICE [SCHWINGUNGSZUSTAND EINES FREMDATOMS IM KUBISCH FLACHENZENTRIERTEN GITTER]**
Edwald Balcar 1964 11 p refs In GERMAN Presented at the Meeting of the Austrian Phys. Soc., Graz, 1964 Submitted for Publication Supported in part by the U.S. Govt.
(SGAE-PH-14/1964) CFSTI: HC $1.00/MF $0.50

Calculations of the effects of a single isotope on the frequency spectrum of a monoatomic crystal with Bravais lattice were performed by evaluation of the general lattice formation. A matrix was found for a cubic surface centered lattice form, that incorporates its specific parameters. Sample calculations on the defect frequencies of a nickel atom in a palladium lattice showed relatively good agreement with measured values.
Transl. by G.G.

**N65-36702#** Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum.
**THE MOSSBAUER EFFECT OF THE 46.5 keV LINE OF W-183] [MOSSBAUEREFFEKT DER 46,5 kev-LINIE VON W-183]**
Manfred Drosg and Endre Ujlaki (Vienna Univ.) 1964 6 p refs In GERMAN Presented at the Fall Meeting of the Austrian Phys. Soc., Graz, 1964 Submitted for Publication
(SGAE-PH-15/1964) CFSTI: HC $1.00/MF $0.50

Measurements of the tungsten$^{183}$ Moessbauer transition on an irradiated tantalum sheet of 0.05 mm thickness are discussed. Decay of the obtained $Ta^{182}$ was shown in the 100 keV Moessbauer niveau of $W^{182}$, and decay of the $Ta^{183}$ was observed in the two Moessbauer niveaux, at 99 keV and at 46.5 keV. Measurements of the 50 keV level with a NaJ scintillating crystal at a temperature of 80° K for both, the source and the absorber, found a resonance absorption of about 4.4 percent for $\gamma$-quanten.
Transl. by G.G.

**N65-36734#** International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center.
**PHONON INTERACTIONS IN CRYSTALS Quarterly Progress Report, 15 Feb.–14 May 1965**
N. S. Shiren, M. Pomerantz, and R. J. von Gutfeld [1965] 30 p refs
(Contract DA-36-039-AMC-02280(E))
(Rept.-8; AD-619273)

The signal velocity of a maser amplified 16.45 Gc/sec ultrasonics has been measured. The measured velocity was unchanged from the off resonance value. Gains of as much as 23 db were obtained. The observed velocity change for 15 db absorption was 15%. A qualitative theory of signal velocity has been derived and is in agreement with the observations. The attenuation of microwave phonons due to interaction with Ga acceptors in Ge has been observed. All the transverse and longitudinal waves propagating on the (100) and (110) directions show effects due to the impurities. The reproducibility of the measurements is rather poor, which may mean that there is some factor affecting the attenuation that is not yet appreciated. Heat pulses have been observed in Bi, Sb and germanium at about 4° K. Preliminary data on Bi and Sb leaves the question of whether electrons or phonons are the principal heat carriers unanswered. Heat pulse data for intrinsic germanium indicate that there is considerable phonon scattering though individual phonon modes are distinguishable.
Author (TAB)

**N65-36747#** Motorola, Inc., Phoenix, Ariz.
**ACTIVE ACOUSTIC DEVICES Third Quarterly Report, 1 Jan–31 Mar. 1965**

N. G. Sakiotis, F. S. Hickernell, and W. H. Brendecke Griffiss AFB, N. Y., RADC, Aug. 1965 76 p ref
(Contract AF 30(602)-3478)
(RADC-TR-65-203; AD-620854)

A heat sink design has been demonstrated which maintains the maximum crystal temperature rise to less than 10° C above ambient for a range of values of drift field power density required for useful continuous acoustic gain. The work on thin film transducers has yielded processes and techniques for the deposition of insulating CdS films on CdS substrates resulting in conversion losses in the range of 6–8 db and bandwidths of the order of 50% in the frequency of 100–300 mc/sec. Bonded quartz transducers operating in the first overtone mode at 180 mc/sec with conversion losses of less than 10 db were demonstrated. Acoustic amplifier utilizing CdS material was shown to operate satisfactorily at maximum crystal temperatures of at least 70° C. Author (TAB)

**N65-36748#** New York Univ., N. Y. Research Div.
**APPLICATION OF ULTRA HIGH PRESSURE TO A STUDY OF ORGANIC SEMICONDUCTORS Final Report, Mar. 1, 1963–Feb. 28, 1965**
Y. Okamoto Jun. 1965 67 p refs
(Contract AF 19(628)-2482)
(AFCRL-65-294; AD-620938)

The electrical conductivity measurement apparatus for organic compounds under the pressure range of 1 to 40,000 atmospheres and at various temperatures (25–400° C) were developed. The effect of pressure and temperature on the electrical conductivity of organic compounds such as organic metallic and charge-transfer compounds were investigated. The effect of pressure on the electrical properties of the organic solids is discussed. Some theoretical consideration on the effects of the structure of organic compounds were made. Author

**N65-36812#** United Kingdom Atomic Energy Authority, Harwell (England). Solid State Physics Div.
**THE FERMI SURFACE OF PALLADIUM**
W. M. Lomer Jul. 1965 10 p refs
(AERE-M-1605) HMSO: 1s 9d

This investigation is intended to help visualise the d-hole Fermi surface in palladium metal. Recent publications have made its dimensions and topology reasonably certain, but no sketches have previously been published. Hybridization between s and d bands is considerable, and has influence on the transport properties, though probably not on the Fermi surface. Author

**N65-36822#** Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
**ELECTRONIC SCIENCES LABORATORY PROGRESS REPORT, APRIL–JUNE 1965**
W. Culshaw et al [1965] 142 p refs
(LMSC-6-75-65-48)

Technical progress on fundamental and applied research in gaseous electronics, solid state electronics, underwater electronics, and information science; is reported. Cited are studies on: coherent light generation, propagation of electromagnetic waves through plasmas, electron physics, electronic structure of crystals, defect state studies in ZnO, spin echo resonance, solid state thin films, wave propagation in randomly inhomogeneous media, auditory data processing, relaxation processes in liquids, a syntactic-statistical method for automatic indexing, speech processing techniques, and internal laser modulation. S.C.W.

**N65-36873#** Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. Solid State Research Branch.
**MEASUREMENT OF ELECTRON FREE LIFETIME AND TRAPPING FACTOR IN HIGH PURITY CADMIUM SULFIDE, CADMIUM SULFIDE/SELENIDE AND CADMIUM SELENIDE USING THE METHOD OF ULTRASONIC AMPLIFICATION**
Barton Krawetz (M.S. Thesis) Mar. 1965 100 p refs
(SP/PH/65-13; AD-616687)

Cadmium sulfide, cadmium sulfide/selenide, and cadmium selenide were studied in an effor to arrive at estimates of several electron transport parameters. Electron free lifetimes, trapping factors, and effective drift mobility were all deduced from direct measurement of the variation of stress wave gain with applied electric field and Hall mobility. Stress wave frequency, crystal bulk conductivity, and temperature were the parameers varied to influence the gain characteristics. Attempts to isolate the characteristic energy level structure of high quality amplifier crystals were made by means of photoconductivity and absorption measurements at 77° K and 300° K. The experimental techniques used in the determination of acoustic gain and Hall mobility in crystals of high resistivity could not result in measurements of a high order of absolute quality. However, they did demonstrate qualitative trends and indicate the level of experimental excellence required to make meaningful, quantitative statements relating to the multitude of effects characteristic of the solid state ultrasonic amplifier. R.W.H.

# 27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

**N65-36231#** AVCO Corp., Stratford, Conn. Lycoming Div.
**HEAT REGENERATIVE SYSTEM FOR T53 SHAFT TURBINE ENGINES**
Jul. 1965 263 p refs *Its* Rept.-2012.3
(Contract DA-44-177-TC-824)
(USAAVLABS-TR-65-37; AD-620245)

A heat regenerator has been designed to demonstrate the feasibility of regeneration for the T53 shaft turbine engine. Parameters of the initial design, a multiwave plate type, were optimized to provide a 27% fuel savings at 75% normal rated power. Test core modules leaked beyond the 0.25% flow-rate limit. Effort was directed toward a conventional tube-type regenerator, which was designed to provide a 24% fuel savings at 75% normal rated power. The tube-type regenerator and the interface hardware have been fabricated and integrated with the engine, and the system is ready for testing. Author

**N65-36443*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
**ON THE CHARACTERIZATION OF MULTIAXIAL DATA IN TERMS OF THE STRAIN ENERGY CONCEPT**
Anthony San Miguel 15 Oct. 1965 15 p refs
(Contract NAS7-100)
(NASA-CR-67400; JPL-TR-32-675) CFSTI: HC $1.00/MF $0.50 CSCL 21I

An experimental–theoretical approach based on continuous media theory has been suggested as a means of

characterizing the multiaxial mechanical behavior of solid propellants (allowing for compressibility). The applicability of this approach to solid propellants has been the subject of one research program. Two multiaxial experiments that have been developed in this program are the inflated cylinder test and the biaxial sheet test. This report deals with characterizing the multiaxial data from these tests in terms of strain energy; only the elastic portion of the viscoelastic response is considered. However, the ultimate aims of the study are to characterize materials with memory. Many of the observations previously reported by the author of compressible propellant were largely repeated upon examination of an unfilled polyurethane binder, which was essentially incompressible. The compressibility theory suggested by the author experimentally converges to the theory as used by Rivlin for an incompressible material. Author

**N65-36890*** National Aeronautics and Space Administration, Washington, D. C.
**FUEL FOR THE ROCKET (1932–1933)**
*In its* Works on Rocket Technol. Nov. 1965 p 385–394 ref (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Predictions for the future of rocketry were made, based on the conclusion that the volatile products of explosion expand in the artificial or natural vacuum and convert their energy into motion. Various engine configurations and explosives were discussed, and several approaches to the problems examined. It was concluded that hydrogen is unsuitable due to its slow density and storage difficulties when in liquid form; and that liquid oxygen is inconvenient, also due to storage problems. The most suitable replacement for oxygen was thought to be nitrogen anhydride; when mixed with benzol, 1,712 cal were liberated per unit. Alcohol and sulfuric ether were also considered suitable. M.G.J.

# 28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

**N65-35841*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
**ANALYSIS OF CHUGGING IN LIQUID-BIPROPELLANT ROCKET ENGINES USING PROPELLANTS WITH DIFFERENT VAPORIZATION RATES**
Leon M. Wenzel and John R. Szuch Washington, NASA, Oct. 1965 14 p refs
(NASA-TN-D-3080) CFSTI: HC $1.00/MF $0.50 CSCL 21H

The model for prediction of low-frequency stability limits for bipropellant rocket engines is modified to include a discrete vaporization time for each propellant, plus a mixing and reaction time common to both propellants. With this modified model as a hypothesis, stability boundaries are calculated for an engine burning liquid oxygen and gaseous hydrogen. The results obtained are, for certain combinations of vaporization and mixing times, converse to those which would be obtained by a lumped-dead-time model such as has been used. For these cases in particular, stability can be improved by decreasing the hydrogen-injector pressure drop, or by increasing the oxygen-vaporization time. Until now, these two concepts have been diametrically opposed to design criteria for stability improvement. The limited data that exist qualitatively support the modified model. For simplicity, factors such as a complex feed system and sensitivity of the dead times to chamber pressure and injection velocity are not included in this analysis. Author

**N65-35968*#** Electro-Optical Systems, Inc., Pasadena, Calif.
**ELECTRON BOMBARDMENT CESIUM ION ENGINE SYSTEM Quarterly Report, 3 May–31 Jul. 1965**
G. Sohl, F. A. Barcatta, and S. Zafran 13 Oct. 1965 37 p (Contract NAS3-7112)
(NASA-CR-54416; EOS-6954-Q-1) CFSTI: HC $2.00/MF $0.50 CSCL 21C

Work performed in the first quarter of a research and development program on an electron bombardment cesium ion engine is reported. Development of engine systems, including zero-g feed systems and neutralizers for extended testing, is described. Preparations for continuous tests of high-performance systems for 2000 and 4000 hours are discussed. Author

**N65-35972*#** Space Technology Labs., Inc., Redondo Beach, Calif.
**MICROMETEORITE BOMBARDMENT INITIATING DISCHARGES AND BREAKDOWN IN ION THRUSTORS**
J. C. Slattery 24 May 1965 45 p refs
(Contract NAS3-5755)
(NASA-CR-54373; STL-4163-6012-SU-000) CFSTI: HC $2.00/MF $0.50 CSCL 21C

The characteristics of arcing induced by the impact of a micron-sized hypervelocity particle in a simulated ion engine was examined. The work pertains to the threat of damage to spacecraft from micrometeorites in outer space. For several ion engine voltages, the probability of discharge formation was measured in clean systems and in the presence of cesium. Damage caused by an arc was examined photographically for tungsten, copper and aluminum electrodes and the effectiveness of a proposed electrical filter was assessed. The free charge produced by a hypervelocity impact was measured for carbon particles and the ion species tentatively identified. Author

**N65-36290#** Giannini Scientific Corp., Santa Ana, Calif.
**RESISTANCE-HEATED THRUSTOR RESEARCH Technical Documentary Report, 1 Feb. 1963–31 Jan. 1964**
James P. Todd Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Jan. 1964 66 p refs
(Contract AF 33(657)-10628)
(GRC-1605; APL-TDR-64-45; AD-349708) (Declassified)

Continued research conducted under a program designed to determine and demonstrate the feasibility of designing, fabricating, and operating, a resistance-heated thrustor based on the contact-resistance principle at a high level of efficiency for a specified period of time; is reported. The specific requirements for this program were to demonstrate at the 3-kw level a thrustor life of 200-hrs at a specific impulse level in excess of 800-sec and an efficiency on the order of 80%. Results of studies at the 3-kw and 30-kw input power levels are described. Primary research at the 30-kw power level using hydrogen as the propellant was completed with a successful 25-hr endurance test on a regeneratively cooled thrustor. A scaled-down version of the 30-kw resisto-jet thrustor was designed, tested, improved, and tested successfully for 200-hrs

at a dc input power level of 3-kw (using hydrogen as the propellant) with negligible erosion and without measureable performance degradation. The size effect on overall performance was confirmed as the 3-kw thrustor exhibited lower values of thrustor efficiency at the same value of specific impulse.
S.C.W.

**N65-36458#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**ROCKET ENGINE GENERATED VOLTAGE AS A SOURCE OF ELECTROMAGNETIC INTERFERENCE AND ELECTRONIC COMPONENT DAMAGE ON INTERPLANETARY VEHICLES**
Leonard Aronowitz Aug. 1965 11 p refs Presented at the 1965 Electron. Symp., Miami, Fla., 2–4 Nov. 1965
(RE-225J)

Electromagnetic interference, damage to electronic components, and other hazards to electronic systems can result from electrical potentials generated by rocket engines. The hazards and the processes in rocket engines which produce them are discussed. It is shown that during the operation of ablative engines, which are generally constructed of dielectric materials, a large electrostatic potential can build up between adjacent portions of an engine. The potential is generated by a current resulting from the motion of the ionized exhaust gas. This potential is capable of producing periodic high voltage discharges and electromagnetic interference. Expressions are given for the magnitude of the current and the repetition frequency of the high voltage discharges as functions of the engine parameters.
R.N.A.

**N65-36460#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**POSSIBLE ELECTROSTATIC EFFECTS OCCURRING IN THE LEM ROCKET ENGINES**
Leonard Aronowitz Jan. 1965 21 p refs
(RM-263)

Some electrical effects that might be produced by an operating rocket engine are qualitatively described. The effects considered include the generation of electrostatic charges and the generation of large differences in potential between various portions of the vehicle. Conditions in rocket engines having metallic combustion chambers and nozzles such as the Lunar Excursion Module (LEM) engines. The effects of metal skirts on the end of the nonconducting nozzle of the LEM descent stage are considered. Two mechanisms that produce electrostatic effects are examined. One involves the motion of electrical charge distributions in the nozzle boundary layer, and the other depends on electrical charges carried into the engine by the fuel and oxidizer. It is concluded that both mechanisms can produce undesirable or even dangerous effects under certain circumstances.
R.N.A.

**N65-36488#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**DYNAMIC INDEPENDENT GALLIUM-INDIUM TRANSPIRATION COOLING Final Report**
W. K. Kretschmer 24 Sep. 1964 56 p
(LMSC-72066)

An advanced transpiration cooling concept for cooling rocket nozzles was developed, in which liquid alloy Ga-In is forced by $N_2$ pressure through the pores of a 79% dense sintered tungsten matrix. In at least four firings the effectiveness of this cooling method was successfully demonstrated. In contrast to these tests, tungsten-infiltrated copper and silver inserts showed considerable throat erosion. In addition, a brazing technique was evolved which resulted in a leak-proved joint between tungsten insert and molybdenum retainer housing. The successful demonstration of the cooling concept opens up a promising method for nozzle cooling applications for high temperature rocket propulsion.
L.S.

**N65-36546#** Aerojet-General Corp., Sacramento, Calif.
**FUEL PUMP CIRCULATING VALVE M-1 ENGINE, ENGINEERING DATA COMPILATION**
J. W. Carriker and D. D. Price 9 Aug. 1965 232 p refs
(Rept.-8800-9)

Proposed solutions are offered for problems relating to flow control, valve friction force, and internal icing in the fuel pump circulating valve (FPCV) for the M-1 engine. The engineering study which led to the final selection of the valve type and the configuration for the FPCV application is presented in detail; and final design layouts are included. The various components and system functioning are described; and consideration is given to full-open position adjustment, auxiliary pneumatic actuation, and retrofit capability. Appendices include a structural analysis summary, various test reports, conceptual and final valve design reviews, and a functional and mechanical analysis.
M.W.R.

**N65-36547#** Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. Electromechanical Div.
**S IVB 150-POUND THRUST AUXILIARY PROPULSION ENGINE Twentieth Progress Report, 26 Jun.–25 Jul. 1964**
5 Aug. 1964 94 p Prepared for Douglas Aircraft Co.
(ER-6136)

Development and reliability activities are presented for the S-IVB 150-pound thrust attitude control rocket engine. Areas included are program management, testing and engine performance, injector and valve development, engine vibration testing, MOD 2 design evaluation, test facilities, materials evaluation, and quality control. Injector development and materials evaluation are emphasized. Two reports were completed in connection with injector development and the significant portions are included. The first report indicates the results of a test to establish the water-to-propellant flow correlation for the injector while discharging to atmosphere and combustion chamber conditions. The second report is the result of metallurgical evaluation of two-pass electron beam welding of tube-collar assemblies. The materials evaluation covers several ablative resin systems, silica fabric, chromia coated silica fabric, and adhesives for structural and sealant purposes.
C.T.C.

**N65-36548#** Thompson Ramo Wooldridge, Inc., Cleveland, Ohio. TRW Electromechanical Div.
**S IVB 150-POUND THRUST AUXILIARY PROPULSION ENGINE Twenty-First Progress Report, 26 Jul.–25 Aug. 1964**
5 Sep. 1964 40 p Prepared for Douglas Aircraft Co., Huntington Beach, Calif.
(ER-6182)

The design and development phase of the Saturn IVB attitude control engine is complete and the manufacturing and testing phases were initiated. Program schedules were revised and are shown. The last three MOD 2 units were rejected because of cleanliness problems. Two MOD 5 injectors were hot gas tested. Some difficulty was encountered in meeting both water and propellant flow requirements. The first MOD 5 production engine has the injector bonded and the first overwrap applied. Boiler problems were resolved and the test facility is now operating satisfactorily. Three major engine tests were conducted. MOD 4 unit 3, containing low resin

content combustion chamber and film adhesive bond lines, successfully completed 426 seconds operating time. MOD 5 S/N 3 successfully completed 148 seconds. A MOD 2 unit was tested to determine the cause of pressure transducer failures. Maximum pressure spikes of 350 psi were measured. A detailed report and data are included. R.N.A.

**N65-36694#** Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Institut für Strahlantriebe.
**DETERMINATION OF THE Q-FACTOR DATA FOR VTOL TRANSMISSION ASSEMBLIES [BESTIMMUNG VON GUTEKENNWERTEN FUR VTOL-TRIEBWERKSANLAGEN]**
Lutz von Bonin 1964 16 p refs In GERMAN Repr. from Luftfahrttech.-Raumfahrttech. (West Germany), v. 9, no. 12, 1964 p 329–343
(DFL-237) CFSTI: HC $1.00/MF $0.50

The overall thrust, frontal-level thrust, and the specific construction volume of the VTOL engine-propeller unit were evaluated for their individual performance influence. A number of parameters were considered for the various conditions connected with a jet lift engine capable of a steep vertical start. Transl. by G.G.

**N65-36761*#** National Aeronautics and Space Administration, Washington, D. C.
**DISCHARGE COEFFICIENT OF SWIRL INJECTORS [O KOEFFITSIYENTE RASKHODA TSENTROBEZHNYKH FORSUNOK]**
R. B. Akhmedov, A. D. Gorbanenko, B. L. Zarkov, and L. M. Tsirul'nikov Oct. 1965 10 p refs Transl. into ENGLISH from Izv. Akad. Nauk Uz. SSR, Ser. Tekhn. Nauk (USSR), v. 9, no. 1, 1965 p 72–76
(NASA-TT-F-9726) CFSTI: HC $1.00/MF $0.50 CSCL 21H

Theoretical and experimental investigation of the observed discrepancy between the analytical and actual values of the discharge coefficient of swirl injectors. The results indicate that for fluids with similar physicochemical properties, an increase in the injector outlet diameter leads to a decrease in the discharge coefficient. The dependence of the discharge coefficient on the viscosity and pressure of the atomized fluid differs substantially depending on whether the injectors have large or small outlet diameters. Author

**N65-36824#** Grumman Aircraft Engineering Corp., Bethpage, N. Y.
**A THEORETICAL INVESTIGATION OF ELECTROFLUIDDYNAMIC PROPULSION IN THE EARTH'S ATMOSPHERE**
A. Maciulaitis Mar. 1965 56 p refs
(RE-204)

The performance of electrofluidynamic (EFD) thrusters of various thickness ratios has been analytically investigated over a wide range of operating conditions in the earth's atmosphere. Numerous configurations were investigated, and results indicate the EFD propulsion does not appear to be applicable for propelling vehicles within the earth's atmosphere. This is due mainly to the requirement for high operating pressure in the EFD channel and the extremely low ratio of the input power to the energy present in the flow. In contrast EFD electrical power generation was found to warrant further study as a possible propulsion mode. G.A.L.

**N65-36880#** Electro-Optical Systems, Inc., Pasadena, Calif.
**THE IONIZATION OF CESIUM IN TUNGSTEN CAPILLARIES**
A. Theodore Forrester Jul. 1964 51 p refs
(EOS-RR-20; AD-615932)

The transport of cesium through a tungsten capillary occurs through two phases, an adsorbed layer and a vapor. In this analysis these two phases are connected by the experimentally observed relationship, rather than by any linearized approximation to it. The choice of allowed solutions is then made by a precise boundary matching to solutions computed for the surface onto which the capillary opens. This analysis leads naturally to the possible existence of three different states of the system for a wide variety of capillary sizes, temperatures, and flow rate conditions. These three states have been correlated with the front surface emitting, pore emitting, and non-emitting states which have been observed to co-exist for a porous ionizer. It is predicted that the coexistence of three different states will disappear when the capillaries become extremely fine. Author

**N65-36866#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**DETERMINING OPTIMUM DEGREES OF COMPRESSION AND EXPANSION IN A COMPLEX GAS TURBINE INSTALLATION**
F. Z. Ratner 5 Apr. 1965 16 p ref Transl. into ENGLISH from Energomashinostr. (Moscow), no. 11, 1963 p 11–14
(FTD-TT-64-1075/1+2; AD-615430)

Formulas were derived for the determination of optimum by maximum efficiency and specific compression and expansion working stages in a complex cycle of a gas turbine installation. Author (TAB)

**N65-36875*#** National Aeronautics and Space Administration, Washington, D. C.
**WORKS ON ROCKET TECHNOLOGY**
K. E. Tsiolkovskiy Nov. 1965 439 p refs Transl. into ENGLISH of the book, Moscow, Publishing House of the Defense Ind., 1947
(NASA-TT-F-243) CFSTI: HC $3.50/MF $2.25 CSCL 21H

CONTENTS:

1. THE WORKS OF K. E. TSIOLKVSKIY ON ROCKET TECHNOLOGY M. K. Tikhonravov p 1–23 refs (See N65-36876 24-28)

2. A ROCKET INTO COSMIC SPACE (1903) p 24–59 refs (See N65-36877 24-28)

3. THE INVESTIGATION OF UNIVERSAL SPACE BY MEANS OF REACTIVE DEVICES (1911) p 60–97 refs (See N65-36878 24-28)

4. THE INVESTIGATION OF UNIVERSAL SPACE BY REACTIVE DEVICES (SUPPLEMENT, 1914) p 99–110 ref (See N65-36879 24-28)

5. INVESTIGATION OF UNIVERSAL SPACE BY REACTIVE DEVICES (1926) p 111–127 (See N65-36880 24-28)

6. COSMIC SHIP (1924) p 218–230 (See N65-36881 24-28)

7. COSMIC ROCKET. EXPERIMENTAL PREPARATION (1927) p 231–248 ref (See N65-36882 24-28)

8. COSMIC ROCKET TRAINS (1929) p 249–283 ref (See N65-36883 24-28)

9. REACTIVE ENGINE (1929) p 284–286 ref (See N65-36884 24-28)

10. THE NEW AIRPLANE (1929) p 287–307 refs (See N65-36885 24-02)

11. THE REACTIVE AIRPLANE (1930) p 308–320 refs (See N65-36886 24-02)

12. ROCKETPLANE (1930) p 321–339 refs (See N65-36887 24-31)

13. SEMI-REACTIVE STRATOPLANE (1932) p 340–372 refs (See N65-36888 24-02)

14. REACTIVE MOTION (1932) p 373–384 refs (See N65-36889 24-31)

15. FUEL FOR THE ROCKET (1932–1933) p 385–394 ref (See N65-36890 24-27)

16. STEAM-GAS TURBINE ENGINE (1933–1934) p 395–402 ref (See N65-36891 24-28)

17. PROJECTILES WHICH ACHIEVE COSMIC VELOCITIES ON LAND OR ON WATER (1933) p 403–413 (See N65-36892 24-31)

18. MAXIMUM VELOCITY OF A ROCKET (1935) p 414–429 (See N65-36893 24-31)

**N65-36876*** National Aeronautics and Space Administration, Washington, D. C.

**THE WORKS OF K. E. TSIOLKOVSKIY ON ROCKET TECHNOLOGY**

M. K. Tikhonravov *In its* Works on Rocket Technol. Nov. 1965 p 1–23 refs (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

An overview of the ideas and published works of Tsiolkovskiy is presented, beginning with his stratospheric airplane with a flight altitude of about 30 km and ending with an interplanetary rocket ship for travel into interstellar space. While it is noted that Tsiolkovskiy officially started work in rocketry in 1903 with the publication of an "Investigation of Universal Space by Means of Reactive Devices", an 1883 paper is entitled "Free Space" and indicates familiarity with the rocket principle of propulsion. He pictures the gradual metamorphosis of the airplane into an interplanetary vehicle; and he proposes to use the incline ascent of a rocket. It is concluded that he did not rule out the possibility of the direct flight of a rocket into cosmic space. M.W.R.

**N65-36877*** National Aeronautics and Space Administration, Washington, D. C.

**A ROCKET INTO COSMIC SPACE (1903)**

*In its* Works on Rocket Technol. Nov. 1965 p 24–59 refs (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Dimensions, weight, and altitude achieved by air balloons is considered along with the temperature and density of the atmosphere. Small unmanned aerostats with automatic sensors, flight to high altitudes by means of shells fired by guns, and the advantages of a rocket are discussed. Flight velocity is tabulated as a function of fuel consumption; rocket efficiency during ascent is considered; and the influence of gravity is detailed. M.W.R.

**N65-36878*** National Aeronautics and Space Administration, Washington, D. C.

**THE INVESTIGATION OF UNIVERSAL SPACE BY MEANS OF REACTIVE DEVICES (1911)**

*In its* Works on Rocket Technol. Nov. 1965 p 60–97 refs (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

A summary of work relating to reactive devices for use in space concludes that the exterior view of the projectile looks like a wingless bird which separates the air in front of it with ease. Liquid hydrogen and oxygen occupy a large part of the projectile's interior; the smaller section of the chamber is designed to house an observer with equipment to preserve his life, conduct scientific observations, and control the rocket. The role of gravity during movement away from the planet, velocity required to move away from the planet, and resistance of the atmosphere are discussed. The period of flight, subsistence during flight, and conditions relating to absence of and increased gravity are also considered. M.W.R.

**N65-36879*** National Aeronautics and Space Administration, Washington, D. C.

**THE INVESTIGATION OF UNIVERSAL SPACE BY REACTIVE DEVICES (SUPPLEMENT, 1914)**

*In its* Works on Rocket Technol. Nov. 1965 p 99–110 refs (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

A popular exposition related to the exploration of space by reactive devices is presented and an attempt is made to refute the view "that the rocket is something far removed from us in time." Several theorems relating to gravity and rocketry are postulated by Tsiolkovskiy, who states that he proposes to use pressure on the rocket ten times greater than the weight of the projectile and its contents. He mentions that he has abandoned an idea to use radium as the explosive which will release energy. A sketchy picture of the phenomena in the explosion tube is given, as is a description of a reactive projectile for cosmic travel. M.W.R.

**N65-36880*** National Aeronautics and Space Administration, Washington, D. C.

**INVESTIGATION OF UNIVERSAL SPACE BY REACTIVE DEVICES (1926)**

*In its* Works on Rocket Technol. Nov. 1965 p 111–217 refs (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Basic data needed to study space flight by reactive devices are considered under the headings of (1) role of gravity during escape from planet, (2) necessary velocities, (3) flight duration, (4) solar gravity, (5) resistance of atmosphere to projectile motion, (6) available energy, (7) cosmic speeds, (8) rocket action and efficiency, and (9) rocket velocity when external energy is utilized. Conversion of thermal energy into mechanical energy, and utilization of heat in the tube, and rocket motion due to explosion in a vacuum or medium free of gravity are investigated. Rocket motion in a medium with gravity (in vacuum) is discussed; resultant acceleration is determined and vertical motion of the rocket is tabulated. Gravity of the atmosphere is considered in relation to rocket flight; and formulas are derived for determination of atmospheric resistance, optimum angle of flight, earth curvature, ascent and descent, and horizontal motion of the projectile. Also discussed are engine and fuel consumption, explosives, rocket components, the plan to conquer interplanetary space, and conditions of life in the ether. M.W.R.

**N65-36881*** National Aeronautics and Space Administration, Washington, D. C.

**COSMIC SHIP (1924)**

*In its* Works on Rocket Technol. Nov. 1965 p 218–230 (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Available means for producing pressure on the body equal to several times its weight are considered in a discussion of cosmic travel. Anticipated difficulties of a cannon with explosives, compressed gases, overheated volatile liquids, and electromagnetism are mentioned. It is suggested that submersion in liquid could safeguard a man from destruction under any increase in gravity, but concluded that this would be true only if man's body were of homogeneous density. Velocity achieved by supporting the body on air like an airplane is less than one percent of the velocity required for escape from Earth. It is suggested that high velocity can be attained by transmitting energy to the projectile from the earth. A parallel beam of electromagnetic waves might transmit energy from the planet with the aid of a large parabolic mirror on the airplane. This is considered in the realm of fantasy, and use of rarefied gas is mentioned as a possibility. Energy released by radium and other gases is discussed, and a cosmic rocket designed by Tsiolkovskiy in 1914 is described. M.W.R.

**N65-36882*** National Aeronautics and Space Administration, Washington, D. C.
**COSMIC ROCKET. EXPERIMENTAL PREPARATION (1927)**
*In its* Works on Rocket Technol. Nov. 1965 p 231–248 (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Experimental preparation for development of a cosmic rocket is considered, and a schematic represents the proposed initial construction of the device. Dimension of the pumps and the nozzle tube; quantity of fuel, flow rate; and efficiency are discussed for a projectile which, including explosives and control mechanisms, would weigh one ton. Oxygen and hydrogen compounds are considered for the ship; it is suggested that liquid air may be used at first. Combustion temperature, cooling the gases at the mouth of the rocket, and materials for the explosion tube are discussed; and provisions for safety are considered. M.W.R.

**N65-36883*** National Aeronautics and Space Administration, Washington, D. C.
**COSMIC ROCKET TRAINS (1929)**
*In its* Works on Rocket Technol. Nov. 1965 p 249–283 ref (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

In this visualization, the cosmic rocket train is described as a combination of several identical reactive devices which first move along a runway, then in air, in vacuum outside the atmosphere, and finally between the planets or the sun. To keep the train in tension rather than compression, the explosion is to start on the first rocket; it was felt that this procedure would achieve higher velocity with the same amount of fuel in each rocket car. Details are given on the construction and operation of the train, and equations are derived for determining the velocity and such relative characteristics as explosive forces, maximum acceleration, path inclination, explosion time, vertical ascent, and train length. Various train systems are discussed, and questions concerning the temperature of a cosmic rocket are examined. M.G.J.

**N65-36884*** National Aeronautics and Space Administration, Washington, D. C.
**REACTIVE ENGINE (1929)**
*In its* Works on Rocket Technol. Nov. 1965 p 284–286 ref (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

The premise is advanced that internal combustion or thermal engines are also reactive engines, and that the reaction of the exhaust gases can be utilized for cosmic flight. Examples are given of the volume of ejected material, and comparisons between fuel supplies and predicted cosmic velocities are drawn. An airplane is described in which the engine is used first to pump air and then, in the rarefied layers of the atmosphere or in vacuum, is used to force the supply of explosives into the explosion tube to achieve cosmic velocities. M.G.J.

**N65-36891*** National Aeronautics and Space Administration, Washington, D. C.
**STEAM-GAS TURBINE ENGINE (1933–1934)**
*In its* Works on Rocket Technol. Nov. 1965 p 395–402 ref (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

A steam-gas turbine engine design for a stratoplane is described, and a labeled schematic diagram of the engine is depicted. The technology of the engine, such as efficiency, compression, heat transfer, power, use of atmospheric oxygen, and operation at high altitudes are discussed. L.S.

**N65-36896*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
**THRUST COEFFICIENTS OF LOW-THRUST NOZZLES**
Ernie W. Spisz, Paul F. Brinich, and John R. Jack Washington, NASA, Oct. 1965 29 p refs
(NASA-TN-D-3056) CFSTI: HC $2.00/MF $0.50 CSCL 21H

The performance losses associated with small nozzles operating at low propellant flow rates were investigated experimentally with a resistance-heated hydrogen thrustor. Data were obtained for seven different nozzles covering the range of nozzle area ratio from 25 to 150, hydrogen propellant flow rates of $0.5 \times 10^{-4}$, $1.0 \times 10^{-4}$, and $2.5 \times 10^{-4}$ pound per second, and propellant temperatures from 530° to 4000° R. The nozzle losses, as determined by the difference between the one-dimensional isentropic thrust coefficient and the measured thrust coefficient, were correlated in terms of the throat Reynolds number and nozzle area ratio. At low throat Reynolds number, the nozzle losses were sufficiently large to result in measured thrust coefficients less than the values calculated for isentropic flow through a choked orifice. Results show that large area ratios are not required for achieving maximum thrust for nozzles with low throat Reynolds number (< 10 000). Author

# 29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

**N65-35778*#** National Aeronautics and Space Administration, Washington, D. C.
**RADIATION DANGER DURING COSMIC FLIGHTS [RADIATSIONNAYA BEZOPASNOST' PRI KOSMICHESKIKH POLETAKH]**
V. G. Bobkov et al Mar. 1965 10 p Transl. into ENGLISH from "Radiatsionnaya Bezopasnost' pri Kosmicheskikh Poletakh" Moscow, Atomizdat, 1964
(NASA-TT-F-9305) CFSTI: HC $1.00/MF $0.50 CSCL 20H

This translation of a preface for a book on radiation dangers during cosmic flight gives a brief outline of the various articles together with a table of contents. The various types of radiation, their origins, measurement methods, and means of protection, as well as experiences and lessons learned during the first space flights were studied. One chapter is devoted to radiation dosimetry methods. G.G.

**N65-35788*#** Consultants and Designers, Inc., Arlington, Va.
**EARTH'S RADIATION BELTS**
S. N. Vernov, E. V. Gorchakov, S. N. Kuznetsov, Yu. I. Logachev, E. N. Sosnovets et al 10 Oct. 1965 41 p refs Transl. into ENGLISH of a paper presented at the 9th Intern. Conf. on Cosmic Rays, London, Sep. 1965
(Contract NAS5-3760)
(NASA-TT-F-9905; PP-PF-10394, Rev.) CFSTI: HC $2.00/MF $0.50 CSCL 20H

Some results of the earth's radiation belt investigation during the solar minimum are reviewed. The results obtained from the Electron series of artificial earth's satellites during

1964 are the main experimental material reported here. Individual typical regions such as the inner and the outer radiation belts are examined. A general picture of the belts which is typical for the epoch of the solar minimum is given. When analyzing the temporal variations in the outer belt and outside its boundary, the satellite data are compared with the data of ground geophysical stations. The development of the radiation belt theory is reviewed in brief. Author

**N65-35881#** Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.

**SPECTRA AND MAGNETIC FIELDS FROM LOCAL SOURCES, HAVING OBSERVED THE SUN DURING THE ECLIPSE OF 15 FEBRUARY 1961**

A. P. Molchanov Bedford, Mass., AFCRL, Jun. 1965 11 p refs Transl. into ENGLISH from Soln. Dannye, Byul. 1962 (Moscow), no. 2, p 53–58
(Contract AF 19(628)-5034)
(G-T-R-65-2; AD-619263)

Observation of the progress of the solar eclipse on a few wavelengths permitted the determination of relative fluxes of the radio waves from two sources. Results are tabulated for wavelengths from 3.15 to 21 cm giving relative flux of radiation from the two sources, flux of unhindered radiation of the sun, dimensions of the sources, and brightness temperature of the source. The results show that the slow constant change of the radio radiation of the sun has a thermal character in the centimeter wavelength range. With the correlation for the retardation of radiated electrons of ionized gas, a conception of the spectrum is formulated and compared with observational data. E.E.B.

**N65-35887** New York Univ., N. Y.

**ACCELERATION PROCESSES IN THE SUN FOR HIGH ENERGY PARTICLES**

Serge A. Korff *In* Comision Nacl. de Invest. Espaciales Intern. Years of the Quiet Sun, Vol. 1 1965 6 p refs (See N65-35883 24-13) CFSTI: HC $4.00/MF $0.75
(Contract AF 19(628)-378; Grant NSF GP-1588)

In recent years several spectacular increases in the intensity of cosmic radiation at sealevel have been noted. These increases correlate in time with large solar flares, and have been called "Solar Flare Injection Events". A consideration of the circumstances and of solar phenomena suggest that the mechanism may be inductive acceleration by changing magnetic fields. However, the acceleration must take place well above the level at which the flare takes place, owing to the need for long free paths and free times. Levels of about 100,000 kms above the photosphere, or about 0.15 solar radius up, seem to be required. Details of the mechanisms are discussed. Author

**N65-35937#** Oslo Univ., Blindern (Norway). Inst. of Theoretical Astrophysics.

**ON THE VELOCITY FIELD IN SUNSPOTS Scientific Report No. 25(47)**

Per Maltby 3 Jun. 1964 68 p refs
(Contract AF 61(052)-186)
(AFCRL-65-424; AD-618242)

Using the tower telescope of the Oslo Solar Observatory approximately 4600 spectra from 62 different sunspots have been obtained. From the study of *weak* Fraunhofer lines the velocity fields in isolated spots and sunspot groups have been derived. For the isolated spots the radial velocity component directed horizontally out of the spot is found to be the largest in most cases, but appreciable tangential velocities are present. An upper limit equal to 0.15 km/sec is found for the vertical velocity component. Sunspot *groups* show a higher frequency of tangential velocities as well as a faster change in the velocity field with time than is the case for isolated spots. An abrupt change in velocity at the outer penumbral rim is detected. The observed line profiles when Evershed velocities are present have been discussed. A comparison between observed and calculated line profiles shows that the velocity changes much more quickly with optical depth than previously assumed. A discussion of the continuity of the motion shows that the vertical velocity component may be small since the density increases rapidly with depth as compared with the increase in horizontal velocity with increasing distance from the spot centre. Author

**N65-35938#** Oslo Univ., Blindern (Norway). Inst. of Theoretical Astrophysics.

**ON SOME PROPERTIES OF SOLAR RADIO BURSTS OF SPECTRAL TYPE III Scientific Report No. 24**

Oystein Elgaroy and Harald Rodberg 23 Aug. 1964 34 p refs
(Contract AT 61(052)-186)
(AFCRL-65-385; AD-616991)

Solar type III bursts have been observed with a swept frequency receiver in the 200 Mc/s range. A mean frequency drift velocity of $-60$ Mc/s$^2$ is found. The observed distribution of bursts of different drift velocities agrees with a calculated distribution curve based on other experimental data and simple assumptions. The time profile of the bursts is slightly asymmetrical, and it is possible to explain the profile from a simple model of the type III phenomenon. The analysis leads to a burst band-width of about 25 Mc/s. If the band-width depends on the size of the exciting disturbance, the source size is about 0.05 $R_\odot$ at the 200 Mc/s plasma level in the corona. Evidence of an increase in the source size on the way out through the corona is presented. The damping constant of the excited oscillations is larger than previously expected. If it is identified with the collision frequency between electrons and ions, a temperature of $2 \cdot 10^{6}$° K is found for the active region corona. Author

**N65-36039*#** National Aeronautics and Space Administration, Washington, D. C.

**VARIATIONS OF COSMIC RAYS AND SOLAR CORPUSCULAR STREAMS: COLLECTION OF ARTICLES [VARIATSII KOSMICHESKIKH LUCHEY I SOLNECHNYYE KORPUSKULARNYYE POTOKI. SBORNIK STATEY]**

S. N. Vernov and L. I. Dorman, ed. Oct. 1965 180 p refs Transl. into ENGLISH of a Publ. of the IGY Program, Sect. VII, no. 2, USSR Acad. of Sci. Press (Moscow), 1960
(NASA-TT-F-91) CFSTI: HC $5.00/MF $1.00 CSCL 20H

CONTENTS:

1. INDIVIDUAL CASES OF THE INFLUENCE OF MAGNETIC STORMS ON COSMIC RAYS AND THEIR INTERPRETATION Ya. L. Blokh, L. I. Dorman, and N. S. Kaminer p 1–63 refs (See N65-36040 24-29)

2. VARIATIONS OF COSMIC RAY INTENSITY DURING THE PERIOD WHEN THE EARTH IS CAPTURED BY CORPUSCULAR STREAMS CARRYING HOMOGENEOUS AND INHOMOGENEOUS FROZEN MAGNETIC FIELDS L. I. Dorman p 64–81 refs (See N65-36041 24-29)

3. DIURNAL VARIATIONS OF THE HARD COMPONENT OF COSMIC RAYS NEAR THE MINIMUM OF SOLAR ACTIVITY Ye. S. Glokova p 82–106 refs (See N65-36042 24-29)

4. DETERMINATION OF THE ENERGY SPECTRUM OF THE PRIMARY DIURNAL VARIATIONS OF THE COSMIC RAY INTENSTIY T. M. Krupitskaya p 107–115 refs (See N65-36043 24-29)

5. CHANGES IN THE AMPLITUDE OF THE DIURNAL VARIATION OF COSMIC RAY INTENSITY AS A FUNCTION OF THE MAGNETIC ACTIVITY N. A. Zhukovskaya and A. I. Ol' p 116–120 refs (See N65-36044 24-29)

6. ANISOTROPY OF COSMIC RAYS CAUSED BY THE ELECTRIC FIELD OF A CORPUSCULAR STREAM L. I. Dorman p 121–126 refs (See N65-36045 24-29)

7. DIURNAL VARIATIONS OF COSMIC RAYS CAUSED BY ANISOTROPIC SCATTERING OF PARTICLES BY INHOMOGENEOUS MAGNETIC FIELDS OF CORPUSCULAR STREAMS L. I. Dorman p 127–150 refs (See N65-36046 24-29)

8. VARIATION OF COSMIC RAY INTENSITY DURING MAGNETIC STORMS WITH SUDDEN AND GRADUAL BEGINNINGS A. I. Ol' p 151–157 refs (See N65-36047 24-29)

9. RELATIONSHIP OF THE COSMIC RAY INTENSITY TO SOLAR ACTIVITY K. K. Fedchenko p 158–163 refs (See N65-36048 24-29)

10. RELATIONSHIP OF THE COSMIC RAY INTENSITY TO THE MAGNETIC ACTIVITY AND RADIO EMISSION OF THE SUN A. I. Ol' and M. I. Tyasto p 164–168 refs (See N65-36049 24-29)

**N65-36040*** National Aeronautics and Space Administration, Washington, D. C.

**INDIVIDUAL CASES OF THE INFLUENCE OF MAGNETIC STORMS ON COSMIC RAYS AND THEIR INTERPRETATION**

Ya. L. Blokh, L. I. Dorman, and N. S. Kaminer *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 1–63 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The paper gives an analysis of several cases of the decrease in the intensity of cosmic rays during the magnetic storms of different types (about 40 storms). For every case the profile is determined of the intensity variations (I, II and III types), the characteristics of which are connected with the properties of the magnetic storm (with sudden or gradual commencement), with the character of capture of the Earth in the corpuscular stream (by forward front or side edge), with the velocity of the stream and its geometric parameters and with the distribution and tension of the magnetic field frozen in the stream. On the basis of conceptions developed an interpretation is given of each case. The properties of streams appear to be largely different. However, general regularities are observed inherent to most of the streams: the angle width of the streams averagely amounts to the angle width of active region; the front edge of the stream is characterised by considerable increase of the magnetic field (and the corresponding compression of plasma); in the leading part of the streams the field is also somewhat increased compared with the field in the lagging edge. Author

**N65-36041*** National Aeronautics and Space Administration, Washington, D. C.

**VARIATIONS OF COSMIC RAY INTENSITY DURING THE PERIOD WHEN THE EARTH IS CAPTURED BY CORPUSCULAR STREAMS CARRYING HOMOGENEOUS AND INHOMOGENEOUS FROZEN MAGNETIC FIELDS**

L. I. Dorman *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 64–81 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The article presents results of calculations of the expected profile of the intensity variations of the neutron and the meson components of cosmic rays. The calculations are given for different cases of the Earth's capture in the stream with homogeneous frozen magnetic field with 300 $H_\delta 01_\delta = 40$, 60, 80, 100 and 120 Bev for the velocities of the front $10^7$, $2 \cdot 1^7$, $3.5 \cdot 10^7$, $6 \cdot 10^7$, $1.2 \cdot 10^7$ and $2.4 \cdot 10^8$ cm/sec. The profile is determined of the variations of the boundary energy of the variations spectrum $\epsilon_{min}$ with the following distribution of the field in the stream: (1) lineary fall from $H_{max}$ at the leading edge of the stream to $H_{min}$ at the lagging edge (with the change of $H_{min}/H_{max}$ from 0 to 1; (2) the fall along the parabola from $H_{max}$ to $H_{min}$; (3) the profile of the field in a triangular form with the maximum at different distances from the leading edge of the stream; (4) the profile of the field with the minimum in the middle of the stream. The profile is also calculated of the $\epsilon_{min}$ changes with different suppositions about the character of field compression in the frontal part of the stream for different cases of the Earth's capture in a stream and for different values of the stream's velocity. Author

**N65-36042*** National Aeronautics and Space Administration, Washington, D. C.

**DIURNAL VARIATIONS OF THE HARD COMPONENT OF COSMIC RAYS NEAR THE MINIMUM OF SOLAR ACTIVITY**

Ye. S. Glokova *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 82–106 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The paper shows that the mean yearly dirunal wave in the hard component of the cosmic rays could be expressed by the sum of two vectors. One of these vectors changes with the cycle of the solar activity, the other, being constant, does not depend on solar activity. When the minimum of solar activity approaches, the amplitude of the variable vector decreases, and this is the main cause of the changes of the observed diurnal wave near the minimum. Data have been received proving the fact that the variable component is created by the anisotropy of cosmic rays outside the limits of the geomagnetic field, and the constant component is mainly of temperature origin. The seasonal changes of the diurnal variation are discussed. The paper shows that the seasonal changes in the Northern and Southern latitudes are to a great extent connected with the temperature effect. However, there are other causes which produce the seasonal changes of the diurnal wave on the equator and the additional seasonal variation in the years of high solar activity. Author

**N65-36043*** National Aeronautics and Space Administration, Washington, D. C.

**DETERMINATION OF THE ENERGY SPECTRUM OF THE PRIMARY DIURNAL VARIATIONS OF THE COSMIC RAY INTENSITY**

T. M. Krupitskaya *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 107–115 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The energy spectrum of the diurnal variations is determined according to the observations materials of the neutron and meson components obtained at a number of stations of the World network for the period of July 1957–June 1958. The relation of amplitudes of the neutron and meson components is applied in the determination of the parameters of the spectrum. It is found that the lower limit of the variations spectrum is (7.1 ±0.9) Bev. Author

**N65-36044*** National Aeronautics and Space Administration, Washington, D. C.

**CHANGES IN THE AMPLITUDE OF THE DIURNAL VARIATION OF COSMIC RAY INTENSITY AS A FUNCTION OF THE MAGNETIC ACTIVITY**

N. A. Zhukovskaya and A. I. Ol' *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 116–120 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The paper uses the data obtained at the 12 stations in the middle and high latitudes for 1957–1958 with corrections for

barometric effect. The amplitude of the diurnal variation is determined by harmonic analysis (1 harmonic). The amplitudes thus received were averaged for several days with different rate of magnetic activity grouped together. The results obtained showed that on the background of continuous increase of the amplitude of diurnal variation with the increase of magnetic activity systematic decrease of amplitude is observed for the group of days with $\Sigma Kp = 24\text{-}33$. The paper discusses the probable causes of the revealed effect. Author

**N65-36045*** National Aeronautics and Space Administration, Washington, D. C.

**ANISOTROPY OF COSMIC RAYS CAUSED BY THE ELECTRIC FIELD OF A CORPUSCULAR STREAM**

L. I. Dorman *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 121–126 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The article gives results of the energy variations under the influence of the electric field and the impulse intervals where the particles acquire or lose energy (with consideration of the influence of the magnetic field in the streams on the trajectories of the particles). Calculations are made for different positions of the Earth in the stream and for different trajectories of the particles (closed and open). The article presents the energy spectrum of the anisotropy which results from the influence of the electric field of corpuscular streams with regular homogeneous and inhomogeneous frozen magnetic field. Author

**N65-36046*** National Aeronautics and Space Administration, Washington, D. C.

**DIURNAL VARIATIONS OF COSMIC RAYS CAUSED BY ANISOTROPIC SCATTERING OF PARTICLES BY INHOMOGENEOUS MAGNETIC FIELDS OF CORPUSCULAR STREAMS**

L. I. Dorman *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 127–150 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The paper discusses diurnal variations of cosmic rays which result from the anisotropic scattering of particles by the frozen regular homogeneous and inhomogeneous magnetic fields. The problem is solved in the general aspect for the field lying perpendicular to the line of the distribution of the stream. The energy spectrum of the variations is found as the function of the local time for different distributions of the magnetic field in the stream without consideration and with approximate consideration of further influence of the magnetic field on the trajectories of the particles. With the application of the coupling coefficients the expected variations of the intensity of the neutron and meson components of cosmic rays are determined on the sea level and on the mountain level at stations with different geomagnetic threshold for different distributions of the frozen field and for different positions of the Earth in the stream. The article gives approximated values of the changes of results in calculation of the diagram of the instruments' direction. Author

**N65-36047*** National Aeronautics and Space Administration, Washington, D. C.

**VARIATION OF COSMIC RAY INTENSITY DURING MAGNETIC STORMS WITH SUDDEN AND GRADUAL BEGINNINGS**

A. I. Ol' *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 151–157 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

According to the observation materials of the meson and neutron components of cosmic radiation obtained at the Heiss I. high latitude observatory and at some middle latitude stations it has been found that in 1957–1958 the magnetic storms with gradual commencement were followed by the increase in the intensity of cosmic rays, while the storms with sudden commencement—by the decrease. In 1937–1946 the storms with gradual commencement were not connected with any significant variations in the intensity of cosmic rays, and large storms with sudden commencement were followed by the decrease. A supposition is offered that the increase in the intensity observed during the magnetic storms with gradual commencement could be characteristic only of this cycle of solar activity due to its extraordinary high level. Author

**N65-36048*** National Aeronautics and Space Administration, Washington, D. C.

**RELATIONSHIP OF THE COSMIC RAY INTENSITY TO SOLAR ACTIVITY**

K. K. Fedchenko *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 158–163 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The article uses the data on the variations of the hard and neutron components obtained at Boukhta Tixie, Heiss I., and in Moscow for the 1954–1958 period with corrections for the barometric effect. The article shows that the effect of cosmic rays connected with the solar activity during the maximum (decrease of intensity) is to a greater extent determined by spots than flocculae; during the minimum this effect is small in both cases. The article also shows that some groups of spots of the largest type, occurring only in the years of high solar activity, while passing across the central zone of the Sun can bring about everywhere (except the equatorial latitudes) considerable increase of the intensity of cosmic rays in the neutron ($\sim 4\%$) and the hard ($\sim 2\%$) components. The paper discusses the possible causes of the increase. Author

**N65-36049*** National Aeronautics and Space Administration, Washington, D. C.

**RELATIONSHIP OF THE COSMIC RAY INTENSITY TO THE MAGNETIC ACTIVITY AND RADIO EMISSION OF THE SUN**

A. I. Ol' and M. I. Tyasto *In its* Variations of Cosmic Rays and Solar Corpuscular Streams Oct. 1965 p 164–168 refs (See N65-36039 24-29) CFSTI: HC $5.00/MF $1.00

The paper presents results of the study of relation between the radio emission of the Sun, the intensity of cosmic rays and magnetic activity according to the registration materials of the solar radio emission at a number of Soviet and foreign stations and the registration of the meson and neutron components of cosmic rays. The study was carried out with the application of the method of epoch overlapping for 1951–1952, 1953–1955 and 1958 periods. The paper shows that the increase of radio emission, connected with the decrease of the intensity of cosmic rays, brings about the increase of magnetic activity, while the increase of radio emission, connected with the increase of the intensity of cosmic rays, is followed by the decrease of magnetic activity. Author

**N65-36113*** Air Force Systems Command, Kirtland AFB, N. Mex. AF Weapons Lab.

**EXPERIMENT D-8, RADIATION IN SPACECRAFT GEMINI IV**

M. F. Schneider, J. F. Janni, and G. E. Radke *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 171–216 (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

An analysis of experiments designed to obtain data on the radiation environment, its shielding interactions, and the dose

rate levels to be encountered, during manned space missions; is reported. Presented are results of specific measurements performed on the Gemini-4. The radiation environment encountered consisted of those energetic protons and electrons present in the inner Van Allen belt, and those encountered each time the Gemini spacecraft passed over the South Atlantic anomaly region. The experiment also included a determination of the ionizing and the penetrating power of various primary and secondary radiations which were present within the spacecraft. Two types of dosimeter systems were used, active and passive. Both passive and active dosimetry data showed that no radiation hazard is associated with manned space operations within the Gemini spacecraft at the altitudes of concern; however, due to the rather high interior dose rates received during several of the anomaly region passes, it appears that limited hazard to biological systems might be realized at considerably higher altitudes during long or extended operations with shielding similar to that of the Gemini spacecraft. Also demonstrated was the feasibility of using flight-qualified space-dosimetry instrumentation packages. S.C.W.

**N65-36133#** Grumann Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.

**SOME DESIRABLE MEASUREMENTS OF AMBIENT RADIATION DURING AN EARLY EXTENDED ENCAMPMENT ON THE MOON**

P. Grinoch, M. D'Agostino, and A. Favale May 1964 8 p refs (RM-230)

The analysis of gamma ray activity of lunar soil and the measurement of the low energy portion of ambient charged particle fluxes and of ambient neutron fluxes are discussed as especially desirable and appropriate for execution during an early extended encampment on the moon such as with the Lunar Exploration System for Apollo (LESA). The experiments suggested are directed at ensuring long term radiobiological safety for future permanent lunar bases and at obtaining information valuable for the study of the universe. E.E.B.

**N65-36173#** Rochester Univ., N. Y. Dept. of Physics and Astronomy.

**A SPARK CHAMBER EXPERIMENT ON COSMIC GAMMA RAYS**

R. Cobb, J. G. Duthie, and J. Stewart [1965] 18 p refs Sponsored in part by AF and NSF

(AD-620882)

The detector used consisted of a scintillation–Cerenkov counter system in conjunction with two spark chambers. The instrument was flown on a three million cubic foot plastic balloon launched from Hyderabad, India on April 5, 1965. The balloon reached an altitude of 119 000 ft and steadily dropped altitude until cut down when at 114 000 ft. The flux of gamma rays at the altitude of the balloon was found to be $4.3 \pm .02 \times 10^{-3}$ gamma rays/sq cm sec sterad. This is an order of magnitude higher than the upper limit of the data from Explorer XI. The gamma rays observed at 6.5 gm/sq cm showed an east-west asymmetry, the ratio of those arriving from the western hemisphere to those arriving from the eastern hemisphere being $1.33 \pm 0.19$. The upper limit of the gamma ray flux from the Crab Nebula as deduced from the Explorer XI data was $6.6 \times 10^{-4}$ per sq cm per second. The present experiment indicated that the probability that the flux is that high is one part in $10^{28}$. Several other strong radio stars were within the sensitive cone of the detector. The time integral of sensitive area together with the number of expected background counts are shown. E.E.B.

**N65-36632#** Polish Academy of Science, Warsaw. Inst. of Nuclear Research.

**A POSSIBLE OCCURRENCE OF VERY HIGH LORENTZ FACTOR CALCULATED USING CASTAGNOLI'S FORMULA IN SECONDARY JETS OF ULTRA HIGH ENERGY [O MOZLIWOSCIACH WYSTEPOWANIA W ODDZIALYWANIACH PROMIENIOWANIA KOSMICZNEGO JETOW WTORNYCH O BARDZO WYSOKIEJ WARTOSCI CZYNNIKA LORENTZA OBLICZONEGO METODA CASTAGNOLI]**

Z. Czachowska Feb. 1965 35 p refs In POLISH; ENGLISH summary

(Rept.-608/VI/PH) CFSTI: HC $2.00/MF $0.50

The influence of the dynamic properties of cosmic ray showers, and particularly, of the masses of colliding particles in primary and secondary interactions, on gamma ray energies was analyzed. D.T.

**N65-36754*#** National Aeronautics and Space Administration, Washington, D. C.

**EVALUATION OF RADIATION CONDITIONS ON THE LUNAR SURFACE [OTSENKA RADIATSIONNOY OBSTANOVKI NA POVERKHNOSTI LUNY]**

A. I. Yikhrov, V. Ye. Dudkin, Ye. Ye. Kovalev, and L. N. Smirennyy Oct. 1965 9 p refs Transl. into ENGLISH from Russian Presented at the 16th Intern. Astronautical Congr., Athens, 13–18 Sep. 1965

(NASA-TT-F-9595) CFSTI: HC $1.00/MF $0.50 CSCL 22A

An estimate of the level of penetrating radiation on the surface of the moon and of the possible radiation hazards for astronauts is attempted. Levels of radiation from all sources are tabulated, indicating that main radiative action would be from galactic cosmic radiation (GCR) and from solar corpuscular radiation (SCR) which latter is more intense during solar chromosphere flares. Protective clothing (light-atom shields of 15 gm/cm$^2$ thickness) and shelters built of lunar soil of about 100 gm/cm$^2$ thickness would lower the tissue does received from GCR by a factor of 3–4 and from SCR to 10 ber. Author

**N65-36791#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**INVESTIGATIONS OF RADIATIONS ON MAN-MADE EARTH SATELLITE COSMOS-17**

S. N. Vernov and A. Ye. Chudakov 16 Apr. 1965 29 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Fiz. (Moscow), v. 28, no. 12, 1964 p 2058–2074

(FTD-TT-65-263/1+2; AD-614402)

The man-made earth satellite COSMOS-17, launched into orbit on May 22, 1963, carried on board an apparatus, intended for studying the radiation belts, on the Earth and primary cosmic radiation. The orbital parameters of the satellite, were as follows: altitude in apogee—788 km, altitude in perigee—260 km, angle of orbital plane inclination to the plane of the equator—49 degrees, period of rotation—98.4 km minutes The report contains data collected by COSMOS-17 and a description of instrumentation. TAB

**N65-36807#** Harvard Coll. Observatory, Fort Davis, Tex. Radio Astronomy Station.

**RADIO EMISSION FROM THE GALACTIC CENTER REGION**

Dennis N. Downes Aug. 1965 51 p refs Sponsored by NSF Revised

Observations of the radio sources in the galactic center region are reviewed and data from other regions of the electromagnetic spectrum are discussed in terms of radio continuum emission. Sagittarius-A has an angular width to half intensity of 3.5 arc min and a nonthermal spectrum with a spectral index of $-0.72 \pm 0.05$ in the microwave range. It appears to have the same linear diameter as the nuclei of other galaxies. Thermal radiation in optically thin regions is suggested by the flat spectra exhibited by two sources adjacent to Sagittarius-A. The 21-cm hydrogen line appears in absorption at the position of Sagittarius-A, indicating that the source is probably at the galactic center. Visible and infrared data also give estimates of distance to the galactic center; X-ray emission has not been detected from galactic center radio sources. M.W.R.

**N65-36870#** San Andrés Univ., La Paz (Bolivia). Cosmic Physics Lab.

**TIME VARIATIONS IN COSMIC RAYS AND RADIOSONDE MEASUREMENTS Final Technical Report**

Ismael Escobar Aug. 1964 133 p refs *Its* Cuaderno No. 27 (Grant AF-AFOSR-63-319)

(AD-615611)

Features observed at Chacaltaya and the results of the measurements obtained with the radiosonde equipment at Ovejuyo are presented. The data registered at Chacaltaya were analyzed and results were compared in some special cases with data from other stations. These analyses involve calculation of harmonic parameters and correlations of cosmic ray events with solar activity in the range of Forbus decreases and diurnal variations. Also, vertical distributions of ozone, winds, and temperature above La Paz, Bolivia are given together with a case study of an ozone sonde rising through a thundercloud. Above the stratospheric ozone maximum, marked changes in ozone mixing ratio were noticed which were consistently related to wind and temperature changes. A sharp ozone discontinuity was detected near the top of a thundercloud. E.E.B.

# 30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

**N65-35789*#** Consultants and Designers, Inc., Arlington, Va.

**OCCURRENCE OF GAS HYDRATES IN THE COMETARY NUCLEI [OCCURENCE DES HYDRATES DE GAZ DANS LES NOYAUX COMETAIRES]**

A. H. Delsemme 5 Oct. 1965 9 p refs Transl. into ENGLISH from French

(Contract NAS5-3760)

(NASA-TT-F-9906; ST-ACH-10395) CFSTI: HC $1.00/MF $0.50 CSCL 03B

A discussion of gas hydrates in the cometary nuclei is presented. Experimental results contributed by Delsemme, Swings, Whipple, Miller, Haser, Vorontsov-Velyaminov, Grudzinska, Liller, Houziaux, Dobronikoff, Baldet, and Wurm are reviewed. The different orders of magnitude for the sublimation rates of $H_2O$, $CH_4$, and $NH_4$ ices for a given temperature are discussed. Results obtained from various calculations of the dimensions of a cometary nucleus are compared. M.R.W.

**N65-35845*#** IIT Research Inst., Chicago, Ill. Astro Sciencies Center.

**TRAJECTORY AND SIGHTING ANALYSIS FOR FIRST-APPARITION COMETS**

P. M. Pierce Jun. 1965 39 p refs

(Contract NASr-65(06))

(NASA-CR-67381; T-13) CFSTI: HC $2.00/MF $0.50 CSCL 03A

The feasibility of sending a probe to a long-period first-apparition comet as a complement to short-period comet missions is discussed. A statistical analysis was performed. Fifty four long-period, first apparition comets sighted between 1945 and 1960 were chosen as a sample. The sample was checked by means of the chi-square $\chi^2$ comparison with 378 similar comets sighted prior to 1945 to determine if the 54 were sufficiently representative. The results indicate significant differences between the two samples, which appear to be attributable to improvement in observational techniques and instruments in recent years. Calculation of ballistic trajectories to each of the 54 comets resulted in the ideal velocity and associated flight parameters for a range of launch dates. The comets were assumed to be discovered at three levels of brightness, and it was concluded that the approach of discovery at magnitude 15 offers enough opportunities so that a mission can be reasonably planned if a moderate search program is initiated. L.S.

**N65-35953*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**STUDY OF DIRECT-RETURN RENDEZVOUS TRAJECTORIES USING CONSTANT-THRUST ENGINES AND RENDEZVOUS OR MANEUVERING THRUSTERS**

James L. Williams and Herman S. Fletcher Washington, NASA, Oct. 1965 23 p refs

(NASA-TN-D-3019) CFSTI: HC $1.00/MF $0.50 CSCL 22C

An analytical study has been made to determine the effect of using two separate engines in the lunar excursion module or lander for direct-return rendezvous with a vehicle in an 80-nautical-mile circular orbit around the moon. A high-thrust engine was used for ascent to establish a nonimpact transfer orbit. After a period of coast, a low-thrust engine was used to complete rendezvous. Only coast trajectories with pericynthion altitudes greater than 25000 feet (7620 meters) were considered, so that in the event of failure of the low-thrust engine the lander would follow a nonimpact orbit. It was found that characteristic velocity (a measure of the fuel consumption), angular distance traveled to rendezvous, and the magnitude of the separation angle between orbiter and lander at lift-off were primarily functions of the initial thrust-weight ratio. The magnitude of the low thrust used for rendezvous had little effect on these parameters in terms of the complete direct-return rendezvous trajectory. From the viewpoint of man-machine consideration, the increased thrust durations associated with low-thrust engines permit more precise control during the final thrusting phase of the direct-return rendezvous. Author

**N65-35974*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

**STATISTICAL ANALYSIS OF PHOTOGRAPHIC METEOR DATA. PART I: OPIK'S LUMINOUS EFFICIENCY AND SUPPLEMENTED WHIPPLE WEIGHTING**

Charles C. Dalton 2 Sep. 1965 77 p refs

(NASA-TM-X-53325) CFSTI: HC $3.00/MF $0.75 CSCL 03B

After adjusting the estimate for the mass of a zero-absolute-visual-magnitude meteor, formulas for meteoroid mass are derived from a physical theory for dustball meteors. Masses

are calculated for a random sample of 285 sporadic photographic meteors. Weighting functions are derived for the statistical minimization of the effects of several sources of bias. Means, standard deviations, and ordinary, multiple, and partial correlations are shown for a 5-variate statistical analysis. Weighted cumulated distributions for parameters are plotted for two gradations with respect to mass. Data-point distributions are plotted which establish cumulative flux as functions of mass, momentum, kinetic energy, etc., which show the effects of the earth's motion on the distributions and correlation of parameters. The results support revisions in the author's interpretation of Explorer XVI data and predicted puncture rates for the Pegasus meteoroid measurement satellites. The apparent discrepancy between the logarithmically linear relations between cumulative flux and mass, as inferred from photographic meteors and from zodiacal light and solar F-corona data, is shown to be accountable by E. J. Opik's probability that a particular meteoroid will encounter the earth in one revolution of the particle. Author

**N65-35976*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**DERIVATION OF PARAMETRIC VALUES FOR A GREENHOUSE MODEL OF THE CYTHEREAN ATMOSPHERE**
Robert B. Owen 7 Sep. 1965 77 p refs
(NASA-TM-X-53327) CFSTI: HC $3.00/MF $0.75 CSCL 03A

Presented is a self-consistent model atmosphere for the planet Venus, with emphasis on parameters of general use in developing vehicle design criteria. Kern and Schilling's program for generation of atmospheric parameter values is coupled with the most recent estimates of surface conditions in order to derive the atmospheric environment at different altitudes. A range of initial values is used to produce a parametric band most representative of actual conditions. Because of the extreme pressures and temperatures involved, it is felt that design for such an environment presents an engineering problem of the first magnitude. Author

**N65-35977*#** National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
**CONIC SOLUTIONS TO THE INTERPLANETARY TRANSFER PROBLEM WITH CONSTANT OR MINIMUM INJECTION ENERGY**
Lamar E. Bullock 16 Aug. 1965 46 p refs
(NASA-TM-X-53319) CFSTI: HC $2.00/MF $0.50 CSCL 22C

This report describes a method for calculating minimum and constant injection energy, $C_3$, values for conic interplanetary trajectories. The planets are assumed to move on mutually inclined elliptical orbits about the sun. Lambert's theorem is used to solve the time-constraint on the two-point boundary value problem, and an iterative procedure, with arrival date as the isolation parameter, is used to determine the desired $C_3$. Typical results are presented for Earth to Jupiter trajectories in the 1970–71 launch period. The comparisons made with previously used methods indicate the procedures described in the report produce results of comparable accuracy, with a savings in computation time. Author

**N65-35980*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**THE MOTION OF A SATELLITE OF THE MOON**
Giorgio E. O. Giacaglia, James P. Murphy, and Theodore L. Felsentreger Jun. 1965 149 p refs
(NASA-TM-X-55295; X-547-65-218) CFSTI: HC $4.00/MF $1.00 CSCL 22A

The motion of a satellite of the moon, or lunar orbiter, was analyzed. The maximum semimajor axis of its orbit was assumed to be of the order of 10000 km. In view of the eccentricity e and $(1 - e^2)^n$ in the denominators of certain expressions, the minimum and maximum values of the eccentricity are functions of the small parameters of the problem. The right-handed, rotating, selenocentric coordinate systems adopted for this problem are: The z-axis is the rotational axis of the moon, and the xy-plane is the moon's equatorial plane. The x-axis passes through the moon's longest meridian m and was assumed to rotate with the motion $n_c^*$. It was shown that a theory which included the moon's oblateness and the earth perturbations included the solar perturbations, unless the orbiter was lower than 8000 km. R.W.H.

**N65-35981*#** Consultants and Designers, Inc., Arlington, Va.
**ON THE INTENSITY AND POLARIZATION OF FORBIDDEN LINES OF THE ION Fe XIII IN THE SOLAR CORONA [SUR L'INTENSITE DE LA POLARISATION DES RAIES INTERDITES DE L'ION Fe XIII DANS LA COURONNE SOLAIRE]**
Jean-Claude Perche 14 Oct. 1965 7 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. Astrophys. (Paris), v. 260, 9 Jun. 1965 p 6037–6040
(Contract NAS5-3760)
(NASA-TT-F-9909; ST-SP-10399) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The intensities I and the polarization rates p of the forbidden lines λλ10747 – 10798 – 3388 Å of Fe XIII ion in the presence of a radial magnetic field are computed, and the calculated results are plotted as a function of the distance to the center of the disk with electron density $N_e$ in parameter and for electron temperature $T_e = 10^{6\circ}$ K. It is seen that p (10747) increases regularly with distance to the center of the disk, r, and reaches a value of 0.6 for r = 1.8 R; that p (10798) < 0.1 for $r \leq 1.8$ R; that p (3388) is $\leq 0.03$; and that the anisotropy of the exciting radiation field has a feeble influence on the ratio R = I (10798)/I (10747). Thus, values of electron density formerly derived from the R ratio while neglecting the radiation field influence, remain valid. L.S.

**N65-36000#** Harvard Coll. Observatory, Cambridge, Mass. Meteor Dept.
**THE STUDY OF METEOR PHENOMENA, UPPER ATMOSPHERE WINDS, AND TURBULENCE AND CHEMILUMINESCENCE IN THE UPPER ATMOSPHERES Final Report**
Allan F. Cook, Richard E. Mc Crosky, and Fred L. Whipple 31 Dec. 1964 212 p refs
(Contract AF 19(604)-5196)
(AFCRL-65-33; AD-616732)

CONTENTS:

1. THE STUDY OF METEOR PHENOMENA A. F. Cook, R. E. McCrosky, and F. L. Whipple 25 p refs (See N65-36001 24-30)

2. UPPER ATMOSPHERIC WIND FIELDS FROM METEORIC TRAINS R. F. Hughes and A. F. Cook 117 p refs (See N65-36002 24-13)

3. OPTICAL PROPERTIES OF SATURN'S RINGS. II: TWO-COLOR PHASE CURVES OF THE TWO BRIGHT RINGS F. A. Franklin and A. F. Cook 68 p refs (See N65-36003 24-30)

**N65-36001** Harvard Coll. Observatory, Cambridge, Mass. Meteor Dept.
**THE STUDY OF METEOR PHENOMENA**
Allan F. Cook, Richard E. Mc Crosky, and Fred L. Whipple *In its* The Study of Meteor Phenomena, Upper Atmosphere Winds, and Turbulence and Chemiluminescence in the Upper Atmospheres 31 Dec. 1964 25 p refs (See N65-36000 24-30)

Seventeen meteoric trains were both photographed and reduced to determine winds in the upper atmosphere. Decay of luminosity has been studied for two trains. Orbits have been determined for 3044 meteors, 413 accurate, 2631 approximate. There is no evidence for hyperbolic orbits, only two meteors appear to have been produced by asteroidal particles, and there is every evidence that nearly all meteors originate from comets. Conclusions from other studies are that particles leave a meteoroid dark and subsequently ablate by vaporization, that the radar meteoric head echo can be caused by ultraviolet photoionization if oxygen has a sufficiently large dissociative recombination coefficient, and that nitrogen and oxygen atoms near 108 km above sea level have a very nonuniform distribution. Other topics studied are the luminous efficiency of meteors, the spectra of meteors, and Saturn's rings. Author

**N65-36003** Harvard Coll. Observatory, Cambridge, Mass. Meteor Dept.
**OPTICAL PROPERTIES OF SATURN'S RINGS. II: TWO-COLOR PHASE CURVES OF THE TWO BRIGHT RINGS**
F. A. Franklin and A. F. Cook *In its* The Study of Meteor Phenomena, Upper Atmosphere Winds, and Turbulence and Chemiluminescence in the Upper Atmospheres 31 Dec. 1964 68 p refs (See N65-36000 24-30)

The B and V photometry of rings A and B of Saturn is presented. The data is used to derive the optical thickness of five representative portions of the ring, and the phase variation and albedo of the ring particles. It is shown that the nonlinear and color-dependent phase curves of the ring near opposition allow two possible interpretations. The more likely model gives the fraction of the ring volume occupied by particles, and a characteristic size of seven microns which is associated with the surface features of these particles. The other model gives the fraction of the ring volume occupied by particles and, in addition, particle radii of ~ 300 microns and a ring thickness of ~10 cm. C.T.C.

**N65-36069** Army Weapons Command, Rock Island, Ill. Weapons Operation Research Office.
**AN HYPOTHESIS CONCERNING THE STRUCTURE OF THE OBSERVABLE UNIVERSE AND ITS RELATION TO THE GRAVITATIONAL CONSTANT AND GALAXY RED SHIFT**
Frederick M. Chakour *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 421–441 (See N65-36050 24-19)

A theoretical approach is taken to the postulate that man can interpret his extradimensional universe in terms of a quasi-three-dimensional sphere in which space curvature is manifested as universal expansion or recession of the galaxies. The general relativity equation employed describes the effect of gravitational fields surrounding spherical masses upon the frequency of clocks, or the effect of gravitation on time. An hypothesis is presented regarding the basic nature of the gravitation constant G, which is the constant of proportionality in Newton's gravitational law; in cgs units, $G = 6.67 \times 10^{-8}$ dyne $cm^2/gr^2$. A theoretical prediction is made of the mathematical relation between the spectral red shift of light coming from receding galaxies and the corresponding galactic distance from the center of the sphere. A recently discovered quasi-stellar radio source (3 C 147) displays a red shift of .545 and is the furthermost object thus far detected. M.W.R.

**N65-36100*#** National Aeronautics and Space Administration, Washington, D. C.
**MANNED SPACE FLIGHT EXPERIMENTS SYMPOSIUM, GEMINI MISSIONS III AND IV**
[1965] 198 p refs Symp. held in Washington, 18–19 Oct. 1965 (NASA-TM-X-56861) CFSTI: HC $5.00/MF $1.25 CSCL 22A

CONTENTS:

1. GEO-ASTRONOMICAL OBSERVATIONS L. Dunkelman, J. R. Gill (NASA, Wash.), F. E. Roach (Inst. of Telecommun. Sci. and Aeronomy), J. A. McDivitt, and E. H. White, II (Manned Spacecraft Center) p 1–18 refs (See N65-36101 24-30)
2. EXPERIMENT S-5, SYNOPTIC TERRAIN PHOTOGRAPHY DURING GEMINI IV P. D. Lowman, Jr. p 19–28 refs (See N65-36102 24-30)
3. EXPERIMENT S-6, SYNOPTIC WEATHER PHOTOGRAPHY DURING GEMINI IV K. M. Nagler (Weather Bur.) and S. D. Soules (Meteorol. Satellite Lab.) p 29–40 refs (See N65-36103 24-30)
4. EXPERIMENT M-3, INFLIGHT EXERCISER ON GEMINI IV L. F. Dietlein (Manned Spacecraft Center) p 41–48 (See N65-36104 24-04)
5. EXPERIMENT M-4, INFLIGHT PHONOCARDIOGRAM L. F. Dietlein (Manned Spacecraft Center) p 49–59 refs (See N65-36105 24-04)
6. EXPERIMENT M-6, BONE DEMINERALIZATION ON GEMINI IV P. B. Mack (Nelda Childers Stark Lab.), G. P. Vose (Texas Woman's Univ.), F. B. Vogt (Texas Inst. for Rehabil. & Res.), and P. A. La Chance (Manned Spacecraft Center) p 61–80 refs (See N65-36106 24-04)
7. EXPERIMENT T-1, REENTRY COMMUNICATION ON GEMINI III L. C. Schroeder, T. E. Sims, and W. F. Cuddihy (Langley Res. Center) p 81–103 (See N65-36107 24-07)
8. EXPERIMENT D-9, SIMPLE NAVIGATION ON GEMINI IV E. M. Vallerie (Space Systems Div.) p 105–119 refs (See N65-36108 24-21)
9. EXPERIMENT MSC-10, TWO-COLOR EARTH LIMB PHOTOGRAPHY FOR GEMINI IV M. Petersen (Mass. Inst. of Technol.) p 121–135 refs (See N65-36109 24-30)
10. EXPERIMENT MSC-1, ELECTROSTATIC CHARGE ON GEMINI III AND GEMINI IV P. Lafferty (Manned Spacecraft Center) p 137–148 (See N65-36110 24-31)
11. EXPERIMENT MSC-2, PROTON-ELECTRON SPECTROMETER ON GEMINI IV J. Marback (Manned Spacecraft Center) p 149–159 ref (See N65-36111 24-14)
12. EXPERIMENT MSC-3, TRI-AXIS MAGNETOMETER ON GEMINI IV W. D. Womack (Manned Spacecraft Center) p 161–170 (See N65-36112 24-14)
13. EXPERIMENT D-8, RADIATION IN SPACECRAFT GEMINI IV M. F. Schneider, J. F. Janni, and G. E. Radke (AFSC) p 171–216 (See N65-36113 24-29)
14. EXPERIMENT S-4, ZERO g AND RADIATION ON BLOOD DURING GEMINI III M. A. Bender, P. C. Gooch, and S. Kondo (Oak Ridge Natl. Lab.) p 217–236 refs (See N65-36114 24-04)

**N65-36101*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**GEO-ASTRONOMICAL OBSERVATIONS**
L. Dunkelman, J. R. Gill (NASA, Washington), F. E. Roach (Inst. of Telecommun. Sci. and Aeronomy, Boulder, Colo.), J. A. McDivitt, and E. H. White II (NASA Manned Spacecraft Center, Houston, Tex.) *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 1–18 refs Prepared in part at NASA, Washington, Inst. of Telecommun. Sci. and Aeronomy, and NASA, Manned Spacecraft Center, Houston, Tex. (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

The nature of airglow, aurora, zodiacal light, the twilight scene, and other celestial phenomena are reviewed in conjunction with observations made from the 62-orbit Gemini 4

mission. A progress report of observations on the following is made: zodiacal light, meteors (below the spacecraft), auroras (over South Australia), nightglow, and twilight horizon blue bands (first observed from Mercury 8 in October, 1962). The photographs of these bands were taken during orbits of Gemini-4. Author

**N65-36102*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**EXPERIMENT S-5, SYNOPTIC TERRAIN PHOTOGRAPHY DURING GEMINI IV**
Paul D. Lowman, Jr. *In* NASA. Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 19–28 refs (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

Results of the synoptic terrain photography experiment, which was successfully conducted during the Gemini-4 mission, are summarized. Analyzed are a continuous series of pictures with near-vertical orientation, which covered the flight path on the 32nd revolution from the Pacific coast of Mexico to central Texas. Included is a discussion of potential geologic applications of space photography. S.C.W.

**N65-36103*** Weather Bureau, Washington, D. C.
**EXPERIMENT S-6, SYNOPTIC WEATHER PHOTOGRAPHY DURING GEMINI IV**
Kenneth M. Nagler and Stanley D. Soules *In* NASA. Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 29–40 refs (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

Presented is a synopsis of photographic data on several cloud systems, which were taken during the Gemini-4 mission. Focused on is the meteorological significance of the synoptic weather photography experiment. Included are pictures taken over southern Florida; Acklin's Island and Crooked Island in the Bahamas; disturbed tropical areas; the Canary Islands; the central northern Pacific; and central Texas. S.C.W.

**N65-36109*** Massachusetts Inst. of Tech., Cambridge.
**EXPERIMENT MSC-10, TWO-COLOR EARTH LIMB PHOTOGRAPHY FOR GEMINI IV**
Max Petersen *In* NASA. Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 121–135 refs (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

A preliminary analysis of several Gemini-4 two-color earth limb photographs is reported. Presented are results of comparative studies of the terrestrial elevation of the blue above the red portion of each photographed limb, in which an arbitrary reference line drawn on the negative was used. It was found that, while the excess elevation of the blue limb tends to increase with the scattering angle, other factors made the correlation far from obvious. The blue limbs were generally less sharp than the red, making the assigned excess elevation dependent on the feature chosen to define the limb. The profiles of the blue limbs were more regular than the red in their brighter parts. Comparative values of the peak radiances, blue and red, of various limbs varied by nearly 50%. It is surmised that the variation of the values of excess blue-limb elevation arises principally from the red limb variance, because the form of the blue limb profiles, at least in their upper part, is more regular than that of the red. S.C.W.

**N65-36136*#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.
**A TRAJECTORY OPTIMIZATION TECHNIQUE BASED UPON THE THEORY OF THE SECOND VARIATION**
Henry J. Kelley (Anal. Mech. Associates, Inc.), Richard E. Kopp, and H. Gardner Moyer Jun. 1964 26 p refs Presented at AIAA Astrodyn. Conf., New Haven, Conn., 19–21 Aug. 1963 (Contracts NAS9-1147; AF 49(638)-1207)
(NASA-CR-67576; RE-177J) CFSTI: HC $2.00/MF $0.50 CSCL 22C

A successive approximation method based upon the theory of the second variation is developed. In the early stage of computation, the process behaves much like the gradient/penalty function process with boundary conditions met only approximately. In the terminal stage, convergence more rapid than that of a gradient method is achieved with "exact" satisfaction of boundary conditions an integral part of the process. Since the equations of variation of the Euler-Lagrange equations are employed in the computational scheme, only slight additional effort is required to perform a check of the generalized Jacobi (Mayer) condition. Author

**N65-36199#** Harvard Univ., Cambridge, Mass. Cruft Lab.
**NONLINEAR FEEDBACK SOLUTION FOR MINIMUM RENDEZVOUS WITH CONSTANT THRUST ACCELERATION**
Arthur E. Bryson, Jr. 15 Jul. 1965 20 p refs
(Contract Nonr-1866(16))
(TR-478; AD-468164)

The instantaneous thrust-direction for a spacecraft to perform a minimum-time rendezvous with another (non-maneuvering) spacecraft is determined as a function of instantaneous relative velocity and position. The magnitude of the thrust acceleration is assumed constant and the acceleration due to external forces is neglected. It is shown that the open-loop solution (bilinear tangent law) can be reduced to a problem in two dimensionless coordinates, $V^2/2ar$ and $\gamma$, where a is the magnitude of thrust acceleration, V is the magnitude of relative velocity, r is the distance between the two spacecraft, and $\gamma$ is the angle between the relative velocity vector and the line-of-sight between the two spacecraft. It is also shown that the open-loop solution can be put in the form of a feedback law depending on the two coordinates. The coordinates can be stated in terms of the rate of rotation of the line of sight relative to a fixed reference axis, and the distance between the spacecraft. For comparison, the minimum-time rendezvous using three constant-thrust-direction periods is presented and the solutions using both methods are very close. L.S.

**N65-36207#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Grumman Research Dept.
**POLARIMETRY AND THE LUNAR SURFACE A Literature Survey**
W. G. Egan Apr. 1965 61 p refs
(RM-271)

Light reflected by illuminated materials exhibits polarization, with properties dependent upon the nature of the surface and the angles of incidence and observation. This is caused by reflection, scattering, diffraction, single and double refraction, and absorption, with all processes occurring simultaneously. A survey was made of the literature on planetary polarization, with particular emphasis on that of the lunar surface, and the results are presented herein. Following a short introduction and history, a brief synopsis of polarization theory and photometric definitions is presented. A description of measuring devices ensues, with data presented on lunar observations and laboratory measurements. Particular emphasis is placed on the work of the French group (Lyot, Dollfus), but not to the exclusion of the Russian workers. The conclusion summarizes the present state of the art, and outlines areas where further investigation is required. An extensive bibliography is included. Author

**N65-36219#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

**GRADIENT TECHNIQUE APPLIED TO THE EXPLORATION OF GRAVITY ON THE EARTH AND THE MOON**

Paul H. Savet Sep. 1965 32 p refs Presented at TECHNION, Haifa, Israel, 8 Jun. 1965

(RE-228J)

The gradient technique offers a practical and immediately realizable method of exploring the gravitational field and its anomalies from an orbiting space vehicle. This exploration does not require a stringent attitude control of the vehicle or a precise knowledge of orbital parameters, such as eccentricity of the orbit or magnitude of its great axis. It is possible to determine by gradient techniques the instantaneous angular velocity of the unit normal to the equipotential, the mean curvature, and the difference in principal curvatures of the equipotential. These measurements could be carried out with three straight gradiometers or two straight and one cross-gradiometer. The technique is applicable to the exploration of local gravitational anomalies on the moon using a manned or unmanned vehicle of observation. R.N.A.

**N65-36296#** Little (Arthur D.), Inc., Cambridge, Mass.

**STUDIES OF THE CHARACTERISTICS OF PROBABLE LUNAR SURFACE MATERIALS**

John W. Salisbury and Peter E. Glaser, ed. Bedford, Mass., AFCRL, Jan. 1964 294 p refs Prepared jointly with AFCRL *Its* Spec. Rept.-20

(Contract AF 19(628)-421)

(AFCRL-64-970; AD-613018)

This report presents the findings on theoretical and experimental studies to determine the nature and most probable physical form of materials on the lunar surface. To accomplish these goals, the following efforts were performed: (1) installation of an ultra-high-vacuum system to simulate the probable lunar environment, (2) selection of material samples to simulate the probable lunar surface, (3) experimentation on and analysis of these materials in a high vacuum, (4) studies of the behavior of clean surfaces in a high vacuum, (5) measurements of electrostatic phenomena in a high vacuum, (6) measurement of thermal properties in a high vacuum, and (7) spectroscopic studies. Author

**N65-36318#** Manchester Univ. (England). Dept. of Astronomy.

**LUNAR COORDINATES AND THEIR DETERMINATION**

**Interim Scientific Report No. 1**

Zdeněk Kopal 3 May 1965 57 p refs

(Grant AF-EOAR-64-49)

(AFCRL-65-589; AD-620242)

The methods of determining the apparent lunar coordinates of a point of the surface of the Moon from a photographic plate are derived from first principles. The theory of the determination of relative heights of features on the lunar surface is rigorously formulated, together with the necessary formulae to account for the effects of solar limb darkening. A more general theory applicable to the case of photographs taken from a spacecraft is also derived. Finally, a comprehensive account of the rotation of the Moon and optical librations is given. Author

**N65-36344#** European Space Vehicle Launcher Development Organization, Paris (France).

**EXPLICIT EQUATIONS OF THE ORBITAL TRANSFER IN A CENTRAL FIELD**

E. Cambi Sep. 1965 14 p

(ELDO-TM-F-22) CFSTI: HC $1.00/MF $0.50

Explicit differential equations are derived, describing the rate of change of the six orbital parameters in terms of the three components of the maneuvering acceleration. It is found that the sixth-order system breaks automatically into two third-order ones, the solution of the second of these being subordered to that of the first. The three first equations exhaust the problem in the case of a plane transfer. Author

**N65-36352#** International Centre for Theoretical Physics, Trieste (Italy).

**CONSIDERATIONS AROUND SO-CALLED COSMOLOGICAL PROBLEMS**

O. Klein Mar. 1965 11 p refs Notes of a Lecture

(IC-65-30) CFSTI: HC $0.00/MF $0.50

The main ideas of Einstein's theory of relativity, and the claims on which it was founded, are briefly outlined as a basis for a critical evaluation of the different branches of cosmology. Einstein's static closed universe theory is reviewed, and several mathematical studies of this subject are discussed. In relation to cosmology, the simplest kind of Friedmann solutions corresponding to pressureless matter, with the density being a function of time, are examined. Particular emphasis is given to the three cases of an expanding or contracting cloud of pressureless matter according to Newtonian theory, having negative, positive, or zero energy with the usual definition of gravitational potential energy. Attempts to replace cosmology by the hypothesis that the metagalaxy is not representative of the universe at large, but just one member of a system of higher order, are also discussed. M.G.J.

**N65-36382#** Royal Greenwich Observatory, Herstmonceux (England).

**THE ABSOLUTE MAGNITUDES OF RR LYRAE–VARIABLE STARS**

Richard Woolley, G. A. Harding, Anneila I. Cassells, and Jennifer Saunders London, HMSO, 1965 36 p refs *Its* Bull. No. 97 CFSTI: HC $2.00/MF $0.50

The mean absolute magnitude of RR Lyrae variable stars is re-examined by comparison of mean proper motions and mean radial velocities. The stars were initially divided into two groups according to period, the break being made at $P = 0^d.45$. The short period group was redivided into two sub-groups using Bailey type as the main criterion. In addition, solutions are obtained using the dispersion $\sigma^2$ the radial velocities and the dispersion of the transverse velocities. Tabular data are given on stars with observed radial velocities; stars with observed proper motions; determination of mean absorption; correction for interstellar absorption; space velocities of Group 1 and Group 2 stars in km/s; and elements of osculating orbits of short-period and longer-period variables. M.G.J.

**N65-36391*#** Hamilton Standard Div., United Aircraft Corp., Broad Brook, Conn.

**MARTIAN ATMOSPHERIC COMPOSITIONAL ANALYSIS: ITS BIOLOGICAL SIGNIFICANCE First Quarterly Progress Report, 15 May–15 Aug. 1965**

Dian R. Hitchcock and J. E. Lovelock (Houston Univ.) [1965] 12 p refs

(Contract NASw-871)

(NASA-CR-67354) CFSTI: HC $1.00/MF $0.50 CSCL 03B

The potential biological significance of two types of atmospheric data is critically reviewed. These are the relationship between the atmosphere and surface material, as revealed by an experiment designed to detect a free energy gradient between the two, and observations of the concentrations of selected major and trace components of the atmosphere including

isotopic abundances. Discussed are studies relating to life detection by detection of chemical free energy in surface matter; Martian atmospheric compositional analyses; and Martian biological atmospheric experiments. M.G.J.

**N65-36430*#** Massachusetts Inst. of Tech., Cambridge. Center for Space Research.
**DYNAMICS OF A SOLAR PRESSURE STABILIZED SATELLITE**
John R. Carroll and Robert C. Limburg (M.S. Thesis) Jun. 1965 70 p refs
(Contract NASr-249)
(NASA-CR-67530; T-65-1) CFSTI: HC $3.00/MF $0.75 CSCL 22C

It is the objective of this thesis to investigate the body dynamics of a solar pressure stabilized satellite in a heliocentric orbit of non-zero eccentricity. The equations of motion for an unsymmetrical satellite are simplified by finding satellite equilibrium position and making small angle assumptions about this position to linearize the equations. The motions predicted by the simplified model are compared with digital computer solutions of the general equations of motion. Passive damping and injection of the satellite into orbit are investigated briefly. In its equilibrium position, the satellite has one principal axis along the radial line. Of the two remaining principal axes, the one with the greater moment of inertia is perpendicular to the orbital plane. For the simplified model, motion about the three principal axes can be uncoupled for small disturbances from equilibrium. Motion about the radial line is characterized by oscillations at approximately orbital frequency rate. Author

**N65-36439*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**ADVANCED RESEARCH: KEY TO THE FUTURE**
[1964] 43 p
(NASA-TM-X-56854) CFSTI: HC $2.00/MF $0.50 CSCL 22A

Studies in aeronautics and space technology, advanced research programs, and modern projects are described. Areas discussed include low speed research, supersonic aircraft, aircraft operating problems, manned space flight simulation, electronic computers in aerospace research, launch vehicle and spacecraft dynamics, materials and structures, hypersonic flight, magnetoplasmadynamics, and man in the space environment. C.T.C.

**N65-36468#** Boeing Scientific Research Labs., Seattle, Wash.
**THE COMPUTATION OF CHARACTERISTIC EXPONENTS IN THE PLANAR RESTRICTED PROBLEM OF THREE BODIES**
André Deprit and J. F. Price Jul. 1965 79 p refs *Its* Math. Note No. 415
(DI-82-0450)

The canonical equation of motion in barycentric synodical Cartesian coordinates and momenta are integrable by recurrent power series to the variation equations. A simple formula is derived, which relates the trace of the monodromy matrix and the characteristic exponents. These numerical methods are applied to evaluate the characteristic exponents of Rabe's Trojan Orbits; they are found to be of the stable type for the ovals, and of the unstable type for the horse-shoe shaped orbit. When the periodic orbit is symmetric with respect to the axis of syzygies, four independent variational solutions computed only over half the period are shown to be sufficient for evaluating the characteristic exponents. Author

**N65-36471#** Joint Publications Research Service, Washington, D. C.
**ANCIENT RECORDS OF NOVAE IN CHINA, KOREA, AND JAPAN, AND THEIR SIGNIFICANCE IN RADIO ASTRONOMY Translations on Communist China's Science and Technology No. 206**
Tse-Tsung Hsi and Shu-Jen Po 16 Aug. 1965 45 p refs Transl. into ENGLISH from K'o Hsueh T'ung Pao (Peiping), no. 5, May 1965 p 387–401 Presented at Peking Sci. Symp., 1964
(JPRS-31564; TT-65-32060) CFSTI: $4.00

Presented are comparative data on novae and supernovae which were taken from the ancient records of China, Korea, and Japan; and a discussion of their significance in radio astronomy. Included are data on supernovae and source of radio waves, and the frequency of supernova outbursts. Also included is a revised table of ancient novae. S.C.W.

**N65-36486*#** Cambridge Univ. (England).
**ON THE NATURE OF THE QUASI-STELLAR OBJECTS**
F. Hoyle and G. R. Burbidge (Calif. Univ., La Jolla) Jul. 1965 47 p refs Prepared jointly with Calif. Univ.
(Grant NsG-357)
(NASA-CR-67577) CFSTI: HC $2.00/MF $0.50 CSCL 03B

The origin of quasi-stellar objects are discussed from two points of view: (1) that these objects are at cosmological distances; and (2) that they are local objects situated at distance from 1 to 10 Mpc. The optical properties of the quasi-stellar objects are compared with the optical properties of galaxies associated with strong radio emission and Syefert nuclei from both points of view. On the basis of this consideration, it is argued that these objects are most probably the nuclei of galaxies which have reached a high density phase at which time the formation of massive objects and their subsequent evolution has occurred. Some of the problems associated with the hypothesis that the objects lie at cosmological distances have arisen through the observation of radio emission from 3C 273B. This shows that at 8000 Mc/sec the intensity has increased by about 40% over the last two years and that the spectrum is flat over the range 200 to 8000 Mc/sec. It is shown that a model based on the synchrotron process is able to explain the form of the spectrum with the object at cosmological distance provided certain conditions prevail. E.E.B.

**N65-36538#** Sandia Corp., Albuquerque, N. Mex.
**AEROSPACE NUCLEAR SAFETY. THE PROBABILITY OF NONNOMINAL ORBITS**
T. S. Edrington and C. H. Goddard Sep. 1965 16 p refs
(SC-RR-65-45)

A method for estimating the probabilities of achieving nonnominal orbits is presented using as a sample problem a mission in which an Atlas-Agena boosts a satellite into a 700 nautical mile circular orbit. Failure modes which lead to nonnominal orbits are identified and probabilities are assigned. A probability distribution of orbit lifetime is derived for each failure mode. These distributions are combined to form a complete distribution which is tabulated. The nominal orbit lifetime for this mission is several thousand years; the particular value depends on which lifetime-versus-geometry data are used. R.N.A.

**N65-36565#** Joint Publications Research Service, Washington, D. C.
**THE GEODETIC NETWORK AND ARTIFICIAL EARTH SATELLITES**
N. P. Yerpylev 15 Oct. 1965 11 p Transl. into ENGLISH from Zemlya i Vselennaya (Moscow), no. 4, Jul.–Aug. 1965 p 65–69
(JPRS-32431; TT-65-32920) CFSTI: $1.00

Presented is a synopsis of reports presented at the National Center for Scientific Research (Paris) symposium at which plans for the creation of a European geodetic network with the help of artificial satellites were discussed. Analyzed are programs utilizing space triangulation and trilateration techniques which are under development in the USSR, the Federal Republic of Germany, France, and the United States. Methods of observation, the development and design of special optical and radiotechnical apparatus, and the development and launching of specially equipped artificial earth satellites; are emphasized A resolution was proposed regarding the establishment of a special international commission for satellite geodesy which would focus on: (1) the study of questions associated with space triangulation and the correlation of this technique with the existing geodetic network; (2) the development of recommendations for methods of observation and computation, and for the design of means of observation; and (3) consultations on types of artificial satellites for geodetic purposes. S.C.W.

**N65-36593#** California Univ., Los Angeles. Dept. of Engineering.
**A STUDY OF HIGH-PRECISION GEOCENTRIC AND INTERPLANETARY ORBITS Technical Status Report No. 1965-1, Jul. 1, 1964–Jun. 30, 1965**
Samuel Herrick [1965] 16 p ref
(Grant AF-AFOSR-241-64)
(Rept.-65-34; AD-620728)

Technical progress in the following related areas is reported: differential representation, orbits from unassociated observations, preliminary orbits from range and range-rate, universal variables, reference data for space trajectories, numerical analyses, partial differential coefficients and quasi-linearization, launch dates for flyby of Mars; and astrodynamical notation, usage, and terminology. S.C.W.

**N65-36620#** Universidad Nacional de Tucuman (Argentina). Facultad de Ciencias Exactas y Tecnologia.
**DEFORMATION OF COSMIC CLOUDS BY PRESSURE OF LIGHT FROM NEARBY STARS [DEFORMACION DE NUBES COSMICAS POR PRESION DE LA LUZ DE ESTRELLAS CERCANAS]**
F. R. Marsicano (Buenos Aires Univ.) 1964 19 p refs In SPANISH; ENGLISH summary *Its* Ser. A, Mat. y Fis. Teorica, Vol. XV, No. 1 and 2 CFSTI: HC $1.00/MF $0.50

One of the aspects of the problem of the deformation of cosmic clouds is investigated; that which combines the gravitational field, the luminous pressure, and the rotation. Computations were made under different conditions varying the density, rotation, luminous pressure, and optical properties of the particles. Luminous pressure is a principal cause of deformation. Clouds with strong luminous absorption are concave towards a star and visa versa for clouds with weak absorption. Under certain circumstances, the luminous tension tends to loosen portions of the cloud in the extremes from the axis at the line that joins the baricenter with the star. Rotation has a stabilizing effect. It opposes any change from the spherical form, but contributes to the expansion of the cloud. For current densities of the cosmic cloud, the interaction between particles and gas is depreciable with respect to particle movement. Transl. by R.N.A.

**N65-36677#** Osservatorio Astronomico di Roma (Italy).
**ECLIPSES OF THE MOON AND THEIR PLACE IN CONTEMPORARY ASTRONOMY [ECLIPSES DE LUNE ET LEUR PLACE DANS L'ASTRONOMIE CONTEMPORAINE]**
Frantisek Link 1964 25 p refs In FRENCH Presented at a Conf. held in Rome, 20 May 1964 *Its* Contributi Sci., Ser. III, No. 26 CFSTI: HC $1.00/MF $0.50

Lunar eclipses are discussed in terms of their relation to contemporary astronomy. Topics considered include: the photometric theory; atmospheric transmission; the calculation of the luminous intensity of a solar ring; the density of the penumbra; the atmospheric ozone; the upper absorbant layer of the atmosphere; and lunar luminescence. Transl. by G.A.L.

**N65-36681#** European Space Technology Center, Delft (Netherlands).
**COVERAGE BY A NETWORK OF TELEMETRY AND TRAJECTORY DETERMINATION STATIONS OF SATELLITES NEAR THE EARTH [COUVERTURE D'UN RESEAU DE STATIONS DE TELEMESURE ET DE TRAJECTOGRAPHIE POUR DES SATELLITES PROCHES DE LA TERRE]**
R. Fraysse Mar. 1965 36 p ref In FRENCH
(ESTEC-MT-9) CFSTI: HC $2.00/MF $0.50

Numeric and graphic methods are defined for calculating the positioning of a network of telemetry stations for satellite tracking. After definition of the rate and zones of coverage, method principles are discussed, in addition to presentation of the formulas used in calculations for the case of a satellite traveling in a circular orbit near the earth. The results of these calculations are then adapted for the case of a satellite traveling in an elliptical orbit. Transl. by G.A.L.

**N65-36691#** Buenos Aires Univ. (Argentina).
**THE COSMOGONICAL HYPOTHESIS REGARDING THE ORIGIN OF THE ROTATION OF THE PLANETS [HIPOTESIS COSMOGONICA REFERENTE AL ORIGEN DE LA ROTACION DE LOS PLANETAS]**
Fenix Roberto Marsicano 1964 16 p refs In SPANISH; ENGLISH summary CFSTI: HC $1.00/MF $0.50

This paper is based on Cernuschi's hypothesis [1, 2] regarding the origin of the solar system. It is assumed in this paper that the mother star of the solar system had a rotation previous to the explosion. The equations of equilibrium of a rotating fluid mass of constant density $10^6$ grem$^3$, is applied to find the maximum angular velocity compatible with equilibrium. Simplified hypotheses are made in order to apply the theorem of the constant kinetic moment and to explain the origin of the rotation of planets supposing these to have constant density. The theory of the rotation of planets, is developed taking into consideration instead of constant density for each planet, a variable density in agreement with the interbal structure of the planets. The corresponding calculations are made for Jupiter. An analysis is made of a possible mechanism which explains the distribution of velocities of planets around the sun and, therefore, the actual kinetic moment of the system. Finally two possible causes are given for the inverted moment of Uranus around its own axis. Author

**N65-36696#** Bonn Univ. (West Germany). Observatory.
**INVESTIGATION OF VW CEPHEI [UNTERSUCHUNGEN AN VW CEPHEI]**
T. Herczeg and H. Schmidt. Ferd. Dummlers, 1960 20 p refs In GERMAN; ENGLISH summary Its Contrib.-57 CFSTI: HC $1.00/MF $0.50

As a contribution to the Coordination Programme recommended by Commission 42 of the I.A.U. two-colour photoelectric observations of VW Cephei were secured at the Observatorium Hoher List (September–October 1959). The isophotic wave-lengths are λλ 4550 and 6000, the total number of measurements is 421. A list of these observations is given together with some 150 additional measurements of the star made in 1954. A short discussion of several possible changes of light-curve and the period follows. A light time effect and thus

the existence of a third body in the system, suspected as early as 1940, is again corroborated; the mass of this third component cannot be less than 0.52 m. Author

**N65-36715#** RAND Corp., Santa Monica, Calif.
**A STOCHASTIC MODEL OF THE FORMATION AND SURVIVAL OF LUNAR CRATERS. II: APPROXIMATE DISTRIBUTION OF DIAMETER OF ALL OBSERVABLE CRATERS**
A. H. Marcus (Case Inst. of Tech.) Aug. 1965 41 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4681-PR; AD-620227)

It is assumed that the number density of lunar craters evolves because of the arrival of new craters and the obliteration of earlier craters by the formation of more recent ones nearby. Approximations are developed which permit the calculation of the expected number density of all observable lunar craters as a function of crater diameter and of time. This result is applied to the meteoroidal impact hypothesis for the origin of lunar craters. It is shown that obliteration alone is not sufficient to explain observed crater diameter distributions. Author (TAB)

**N65-36810#** Joint Publications Research Service, Washington, D. C.
**SOME RESULTS OF THE STUDY OF OUTER SPACE INVESTIGATIONS CONDUCTED ON THE "KOSMOS" AND "ELEKTRON" SATELLITES**
G. A. Skuridin 13 Oct. 1965 28 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 8, Aug. 1965 p 3–18
(JPRS-32383; TT-65-32873) CFSTI: $2.00

The design and instrumentation of the Kosmos and Elektron series of satellites are described, and the specific studies undertaken by each are discussed. The Kosmos series are used to study such problems as reentry, landing in an assigned region, radiation protection of the spacecraft, reliability of life support systems, and the development of an orientation system; the Elektron satellites conduct a broad spectrum of measurements on the physical processes in various regions of near space. Details are given on several experiments, including spatial and energy distribution of charged particles in the 0.1 to 10 keV energy range; distribution of radiation doses at different altitudes; correlation of electron stream with magnetic measurement; measurements of nuclear component of primary cosmic radiation; and a world magnetic survey. Results indicate that a close interrelationship exists between magnetic storms, polar aurorae, and the earth's radiation belt, and it was concluded that the main dynamic process determining geophysical occurrences is the interaction of the solar corpuscular streams with the geomagnetic field. M.G.J.

**N65-36811#** Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
**THE SELENODETIC CONTROL SYSTEM OF THE AERONAUTICAL CHART AND INFORMATION CENTER OF THE U. S. AIR FORCE**
C. L. Goudas Jun. 1965 36 p refs *Its* Math. Note No. 413
(DI-82-0443)

Values of the coefficients $J_{ij}$ and $J'_{ij}$ of the expansion into spherical harmonics of the surface of the moon as presented by the selenodetic control system of the Aeronautical Chart and Information Center (ACIC), U. S. Air Force, are derived. Data for the marginal zone are taken from the maps of Watts and Hayn, and the measurements of Davidson and Brooks. It is found that the present values are in good agreement with those derived on the basis of the same data by Schrutka-Rechtenstamm and the Army Map Service. The ACIC Control System approximates best the figure of the moon as this is derived from the study of its physical libration on the assumption of homogeneity. Author

**N65-36865#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PREDICTION OF TRAJECTORY OF SPACE VEHICLE UNDER DISCRETE CONTROL**
V. A. Yaroshevskiy 25 May 1965 22 p refs Transl. into ENGLISH from Russian
(FTD-MT-65-126; AD-615859)

The problems of prediction of space vehicle trajectories are discussed and equations are derived using the theory of random functions for the determination of parameters of space vehicle motion. Also, the problem of trajectory corrections for space flight for entry into planetary atmospheres is considered. E.E.B.

# 31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

**N65-35775*#** National Aeronautics and Space Administration, Washington, D. C.
**TWELFTH SEMIANNUAL REPORT TO CONGRESS, JULY 1-DECEMBER 31, 1964**
[1964] 245 p refs GPO: $1.00/CFSTI: MF $1.25 CSCL 22B

A summary of the activities and accomplishments of NASA during the latter half of the year 1964 is presented. Covered are the preparations made for the first manned flight in Project Gemini, photographs of the moon sent back by spacecraft, the Mars mission spacecraft, meteorological satellites, communications satellites, and international cooperative endeavors. Also discussed are the nuclear rocket technology program, tracking and data acquisition, and personnel management, procurement, and support functions. Illustrations and tables are included in the report. L.S.

**N65-35793*#** Martin Co., Baltimore, Md.
**CONCEPTUAL STUDY OF A MICROMETEOROID DEEP SPACE SATELLITE. VOLUME I: SUMMARY, DEVELOPMENT PLAN, PRICING Final Report**
Edward C. Weissmann et al Jan. 1965 158 p
(Contract NAS1-4162)
(NASA-CR-66021; ER-13700-I) CFSTI: HC $5.00/MF $1.25 CSCL 22B

A conceptual study of a satellite to investigate the meteoroid environment between the earth and the moon is reported. The four-volume report concerns mission objectives and sensor constraints, selection of the Atlas (SLV-3)/Agena D launch vehicle, orbit stability and launch window, orbit tracking, and probability of mission success. See Accession Numbers N65-35794 through N65-35796 for separate volumes. J.M.D.

**N65-35794*#** Martin Co., Baltimore, Md.
**CONCEPTUAL STUDY OF A MICROMETEOROID DEEP SPACE SATELLITE. VOLUME II: EXPERIMENTAL OBJECTIVES AND SENSORS, TELECOMMUNICATIONS Final Report**

Sidney L. Russak et al Jan. 1965 316 p refs See N65-35793 for abstract
(Contract NAS1-4162)
(NASA-CR-66022; ER-13700-II) CFSTI: HC $7.00/MF $1.75 CSCL 22B

**N65-35795*#** Martin Co., Baltimore, Md.
**CONCEPTUAL STUDY OF A MICROMETEOROID DEEP SPACE SATELLITE. VOLUME III: ORBITAL MECHANICS, POWER SUPPLY AND DISTRIBUTION, VEHICLE DESIGN, THERMAL CONTROL, ATTITUDE SENSING AND DETERMINATION Final Report**
William J. Pragluski et al Jan. 1965 343 p refs See N65-35793 for abstract
(Contract NAS1-4162)
(NASA-CR-66023; ER-13700-III) CFSTI: HC $7.00/MF $1.75 CSCL 22B

**N65-35796*#** Martin Co., Baltimore, Md.
**CONCEPTUAL STUDY OF A MICROMETEOROID DEEP SPACE SATELLITE. VOLUME IV: RELIABILITY Final Report**
Charles D. Hoover et al Jan. 1965 218 p See N65-35793 for abstract
(Contract NAS1-4162)
(NASA-CR-66025; ER-13700-IV) CFSTI: HC $6.00/MF $1.25 CSCL 22B

**N65-36110*** National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
**EXPERIMENT MSC-1, ELECTROSTATIC CHARGE ON GEMINI III AND GEMINI IV**
Patrick Lafferty *In* NASA, Washington Manned Space Flight Expt. Symp., Gemini Missions III and IV [1965] p 137–148 (See N65-36100 24-30) CFSTI: HC $5.00/MF $1.25

Gemini-4, data indicated an electric field at the spacecraft surface that was appreciably higher than expected. Postflight testing showed that the experiment instrument was sensitive to radio frequency interference (RFI) and fluxes of charged particles. The experiment was also carried on the Gemini-5 mission, but equipment was modified to inhibit the electric field incident on the sensing face of the sensor unit so that a measurement could be obtained of the remaining stimuli. Results indicate that the contribution of an electrostatic field charge on the Gemini-4 instrument was negligible. Author

**N65-36202#** Martin Co., Denver, Colo.
**ON THE SELECTION OF UNMANNED PROBES AND LAUNCH VEHICLES FOR EXPLORATION OF THE SOLAR SYSTEM**
George W. Morgenthaler 25 Aug. 1964 104 p refs Presented at the 10th Ann. and 1st Intern. Meeting of Operations Res. Soc. of Am., Western Sect., Sponsored by Operations Soc. of Japan and Hawaii Univ., Honolulu, Hawaii, 14–18 Sep. 1964
(R-64-9)

Consideration is given to the various types of measured data that are to be taken such as: meteorite data, magnetic fields, solar winds, planetary atmospheric data, experiments involving the search for life, and data pertaining to planetology. How much data? How many probe launches, and to which targets? The experimental requirements must be interpreted as to instrumentation weights, reliabilities, resolution accuracies, and costs. Finally, the available launch vehicles and upper stages must be matched to probe requirements in such a way that payload weight, trip time, amount of reliability redundancy, and booster direct and indirect costs are all varied so as to achieve an overall optimum program. A model is developed in this paper to analytically compare the above factors within the framework of the overall National Space Program. The model is applied to an example and some tentative conclusions are drawn. Data which need refinement and further engineering study are pinpointed. The cost and performance data shown in the example are plausible, but not authoritative. Author

**N65-36381#** British Aircraft Corp., Stevenage (England). Guided Weapons Div.
**FERRITE ROD AERIAL TEMPERATURES: UK-3 SATELLITE**
B. Stockwell Jan. 1964 11 p
(UK-3/TN-14) CFSTI: HC $1.00/MF $0.50

The thermal performance of several possible composite aerial structures (models) in different orbit-attitude combinations was studied in an attempt to define the aerial temperature range of the boom-mounted ferrite rod aerials in the UK-3 satellite. The aerials studied were wrapped in a jacket of polished aluminum to provide a surface of high absorptivity: emissivity ratio. In view of the tentative requirement for the aerial temperature to lie within the range 0° C to 50° C, the ratio was set at 1.5. The finish consisted of a combination of sandblasted aluminum and grey paint. Two finishes were considered having absorptivity:emissivity ratios of 0.24 and 0.70. Results of heat balance calculations showed that the aerial temperature range in orbit, with an aerial wrapped in painted insulation, should lie within the range of −25° C to +35° C. The temperature range can be raised by the application of a special finish to the insulation outside surface. A metallic special finish is recommended, the best being a combination of sandblasted aluminum with medium grey paint, the proportions by area of the two materials being 86:14 respectively. With this finish, the aerial temperature in orbit should lie within the range −10° C to +65° C under all conditions. S.C.W.

**N65-36550*#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**VOYAGER DESIGN STUDY. VOLUME V: STERILIZATION**
15 Oct. 1963 76 p refs *Its* Doc. No. 63SD801
(NASA Contract NASw-696)
(NASA-CR-51840) CFSTI: HC $3.00/MF $0.75 CSCL 22B

Areas discussed in the sterilization of the voyager spacecraft include: (1) classification of components, (2) launch area operations, (3) biological barriers, (4) sterilization with ethylene-oxide, (5) radiation sterilization, (6) thermal sterilization, (7) sterility control group, and (8) microbiological analysis. It was concluded that a biologically sterile spacecraft is technologically feasible and within the state-of-the-art expected by 1967. A complete thermal sterilization for Voyager with its present mission could not be done with components available today; however, if the recommended development programs are carried out successfully, thermal sterilization, as outlined, is possible. The presence of liquids, gases, radio-active power supplies, requirements for late assembly of explosives and practical handling difficulties indicates that some post-thermal treatment sterile assembly may be required. P.V.E.

**N65-36551*#** General Electric Co., Philadelphia, Pa. Missile and Space Div.
**VOYAGER DESIGN STUDY. VOLUME VI: PROGRAM PLANS**
15 Oct. 1963 215 p *Its* Doc. 63SD801
(Contract NASw-696)
(NASA-CR-61841) CFSTI: HC $8.00/MF $1.25 CSCL 22B

Problems in the development of the Voyager systems are discussed and approaches to their solution are presented in the following areas: (1) lander sterilization requirements and

their effects on (a) materials, (b) parts and components, (c) lander system design, (d) production processes and facilities, (e) field processes and facilities; (2) long-term space soak effects—(a) propellant corrosive effects, (b) battery pneumatic-system leakage, (c) operation of mechanisms, (d) simulated space environmental testing; (3) high-reliability requirements—(a) system reliability, (b) component reliability and life, (c) manufacturing and testing, (d) handling, servicing, and checkout; (4) entry to, landing, and operation on Mars—(a) entry of lander, (b) impact survival and environment, (c) experiments and data processing; and (5) other problem areas—(a) radioisotope thermoelectric generators, and (b) data storage and communication. P.V.E.

**N65-36552*#** AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
**VOYAGER DESIGN STUDIES. VOLUME VI: DEVELOPMENT PLAN**
15 Oct. 1963 66 p
(NASA Contract NASw-697)
(NASA-CR-51831; RAD-TR-63-34) CFSTI: HC $3.00/MF $0.75 CSCL 22B

The development plan leading to the launch of the Voyager unmanned orbiter-lander spacecraft during the Mars 1969 opportunity is presented. The major subsystem and disciplinary efforts involved are indicated, the development schedules are discussed, and the costs of the program are summarized. The development plan shows that to obtain the scientific value desired from this mission, two spacecraft should be scheduled for each launch opportunity, and hardware development should begin in 1964 to meet the 1969 launch date for Mars. M.P.G.

**N65-36671#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**THE FAMOUS VOSTOR FIRST MANNED SPACE SHIP**
16 Jul. 1965 11 p Transl. into ENGLISH from Russian
(FTD-TT-65-763/1+4; AD-618900)

Vostok is a single place sputnik composed of a detachable capsule and an instrument compartment joined by four couplings. The detachable capsule is a sphere with a weight of 2.4 tons and protects the astronaut's compartment. All onboard systems were reported to have functioned normally. Powerful carrier stage rockets have placed the Vostoks in orbits characterized by an 89 minute revolution period and an inclination of almost 65° in relation to the equator. R.W.H.

**N65-36698#** Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
**THE IMPORTANCE OF A EUROPEAN SPACE TRANSPORT FOR THE GERMAN AIR- AND SPACEFLIGHT INDUSTRY AND RESEARCH [BEDEUTUNG EINES EUROPAISCHEN RAUMTRANSPORTERS FUR DIE DEUTSCHE LUFT- UND RAUMFAHRTINDUSTRIE UND -FORSCHUNG]**
J. Lambrecht 27 Jul. 1965 30 p In GERMAN Presented at the 5th European Spaceflight Symp., Munich CFSTI: HC $2.00/MF $0.50

Development possibilities of a European space transport vehicle are evaluated with emphasis on the involved cost estimates. The space transporter is visualized as a piggy-back form of two or three airplane-like stages; the top stage will be powered by rocket propulsion with $O_2/H_2$ as fuel; and the start will be in horizontal direction. A possible catapult start is evaluated. Transl. by G.G.

**N65-36887*** National Aeronautics and Space Administration, Washington, D. C.
**ROCKETPLANE (1930)**
*In its* Works on Rocket Technol. Nov. 1965 p 321–339 refs (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

The operation and flight characteristics of a proposed rocketplane are described, and construction details are given. Methods of increasing fuel consumption are examined, with particular emphasis given to compression problems. Tabular data are included on air densities for various altitudes above sea level, and computations are given for the resistance encountered at sea level for various velocities. Calculations are also included on the motion of the airplane, specifically the horizontal and vertical velocities, the corresponding density of the medium, and its resistance. M.G.J.

**N65-36889*** National Aeronautics and Space Administration, Washington, D. C.
**REACTIVE MOTION (1932)**
*In its* Works on Rocket Technol. Nov. 1965 p 373–384 refs (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Methods of achieving high velocities are discussed, and the feasibility of using large fuel supplies is considered. Safety measures are suggested for (1) conditions where the weight of fuel and oxygen is 15 times greater than the weight of the rocket; (2) manned flights in the stratosphere and in vacuum; and (3) lightweight and proper operation of the rocket. A schematic of a reactive device is included; this consists of an impermeable, extremely elongated, thermally insulated surface; a conic tube with a carburetor for mixing liquid oxygen and petroleum; two small pumps; and a very weak engine. Auxiliary means for attaining cosmic velocity are also discussed. M.G.J.

**N65-36892*** National Aeronautics and Space Administration, Washington, D. C.
**PROJECTILES WHICH ACHIEVE COSMIC VELOCITIES ON LAND OR ON WATER (1933)**
*In its* Works on Rocket Technol. Nov. 1965 p 403–413 (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

Both the advantages and shortcomings of projectiles which achieve cosmic velocities on land or on water are compared with respect to similar projectiles achieving the velocities at high altitudes. Some of the factors considered are utilization of power sources from installations on the ground, fuel reservoirs, supplementary power sources, friction resistance, projectile size, gravity effects, and projectile weight. Calculations are given for velocity, friction, work of inertia, work performed, and acceleration. L.S.

**N65-36893*** National Aeronautics and Space Administration, Washington, D. C.
**MAXIMUM VELOCITY OF A ROCKET (1935)**
*In its* Work on Rocket Technol. Nov. 1965 p 414–429 (See N65-36875 24-28) CFSTI: HC $3.50/MF $2.25

A theoretical analysis of rocket velocity, showing the relation between the velocity of a rocket and the explosive thrust is presented. A table is given showing the maximum rocket velocities as a function of the total expended supply of fuel and the relative velocity of the ejected fuel. The percentage efficiency of the energy converted to rocket motion is also listed. It is small but as the relative quantity of fuel increases, the efficiency increases. Another table showing the velocity of the fuel explosion, the utilization of heat, and the final velocity of the rocket after the entire supply of fuel is expended is also given. The velocity that can be reached by one rocket when assisted by auxiliary rockets is also discussed, along with theoretical computations. L.S.

# 32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

**N65-35826*#** Boeing Co., Seattle, Wash. Aerospace Group.
**METEOROID PROTECTION FOR SPACECRAFT STRUCTURES Final Report**
J. F. Lundeberg, P. H. Stern, and R. J. Bristow Oct. 1965 104 p refs
(Contract NAS3-2570)
(NASA-CR-54201; D2-24056) CFSTI: HC $4.00/MF $0.75 CSCL 20K

A procedure to determine meteoroid-protection requirements for spacecraft structures has been developed based on the meteoroid environment, acceptable risk, mission exposure, and structural response to impact. A rational evaluation of impact damage, based on hypervelocity test data, permits selection of barrier elements for minimum-weight protection, or determination of the maximum particle that can be defeated by an arbitrary barrier configuration. The effect of stress and hypervelocity impact on aluminum tankage at cryogenic temperatures is investigated. The critical stress to resist catastrophic fracture is determined for a range of impact damage patterns, material thicknesses, and operating temperatures. Author

**N65-35835*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**EXPERIMENTAL FLUTTER STUDY OF A WING-FUSELAGE CONFIGURATION AT A MACH NUMBER OF 15.4 AND COMPARISON WITH THEORY**
Robert C. Goetz and John L. Sewall Washington, NASA, Oct. 1965 47 p refs
(NASA-TN-D-3046) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The models were sting-mounted in the 24-inch-diameter leg of the Langley Mach 15 hypersonic aeroelasticity tunnel on a support system which simulated the free-flight condition by permitting symmetric freedoms of vertical translation and pitch. The fuselage was cylindrical with a semirigid spherically blunted nose-cone section, and the wing was a 73° clipped delta with a modified trailing edge and a slab airfoil section. The model geometry and mass distribution were held constant while the ratio of wing stiffness to fuselage stiffness was varied. The results indicate that increasing the wing-to-fuselage frequency ratio from 0 to about 1.0 is destabilizing, whereas a further increase in frequency ratio is stabilizing. From these results the fuselage flexibility was concluded to be an important flutter parameter. The stiffness of the model support system was at a level low enough to have no measurable effects on the flutter characteristics of the models in the present investigation. Flutter calculations for some of the models were performed by application of a flutter analysis based on the first four coupled symmetric modes and on quasi-steady aerodynamic theory for approximating aerodynamic forces acting on wing and fuselage. Author

**N65-35838*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**VIBRATION TESTS OF PRESSURIZED THIN-WALLED CYLINDRICAL SHELLS**
Robert Miserentino and Louis F. Vosteen Washington, NASA, Oct. 1965 48 p refs
(NASA-TN-D-3066) CFSTI: HC $2.00/MF $0.50 CSCL 20K

The breathing vibration modes of seven unstiffened cylinders having radius-to-thickness ratios ranging from 324 to 1622 have been determined. Six cylinders were made of stainless steel and one, of aluminum. Their nominal length-to-radius ratio was six. Experimental results are presented to show the variations of resonant frequency and mode shape with internal pressure. The experimental results compared favorably with Reissner's analysis based upon Donnell's equation. However, the theory tended to overestimate the frequency increase which resulted from an increase in internal pressure. Author

**N65-35859** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**POISSON'S RATIO IN COMPRESSIBLE VISCO-ELASTIC MEDIA**
V. A. Zhalin *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 109–115 refs (See N65-35850 24-23)

A study of the behavior of Poisson's ratio in bodies with viscoelastic compressibility is presented. A solid, for which processes of shift and volume deformation are described by different models, is considered. Kelvin body, Maxwell body, and certain combinations of these two elements are used as the models. C.T.C.

**N65-35926#** David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.
**COMPUTATION OF OSCILLATORY LOADS ON A SUPERCAVITATING HYDROFOIL**
Jon Patton and Avis Borden Aug. 1965 38 p refs
(DTMB-1840; AD-467044)

Frequency functions and unsteady lift and moment coefficients for a hydrofoil oscillating sinusoidally in pitch and heave have been computed using a theory developed by L. C. Woods for an airfoil fitted with a spoiler. A cavity of infinite length is assumed to spring from an arbitrary point on the upper surface of the hydrofoil and extend aft to the trailing edge. Computed frequency coefficients and loading coefficients are tabulated for six locations of the separation point over a range of reduced frequencies from 0.01 to 20.0. Author

**N65-35950*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
**MEMBRANE ANALYSIS OF PRESSURIZED THIN SPHEROID SHELLS COMPOSED OF FLAT GORES, AND ITS APPLICATION TO ECHO II**
Hossein Bahiman Washington, NASA, Oct. 1965 13 p refs
(NASA-TN-D-3002) CFSTI: HC $1.00/MF $0.50 CSCL 20K

Membrane analysis of very thin pressurized spheroid shells composed of flat gores led to a set of nonlinear differential equations for three membrane displacements. An approximate solution by the perturbation technique is established. As an example, the approximate shape of Echo II is computed. Author

**N65-35958*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**SUPERSONIC FLUTTER OF A THERMALLY STRESSED FLAT PANEL WITH UNIFORM EDGE LOADS**
Harry G. Schaeffer and Walter L. Heard, Jr. Washington, NASA, Oct. 1965 26 p refs
(NASA-TN-D-3077) CFSTI: HC $1.00/MF $0.50 CSCL 20K

The effect of a nonuniform, self-equilibrating stress state associated with a parabolic temperature distribution is included in the flutter analysis of a rectangular, simply supported panel subjected to airflow over one surface and uniform edge loads. Linearized, static, two-dimensional aerodynamics is used in

conjunction with thin-plate theory to formulate the problem. Numerical results for a square panel show that nonuniform self-equilibrating stresses are as important as uniform stresses in affecting flutter behavior. Author

**N65-35967*#** National Aeronautics and Space Administration, Washington, D. C.
**FUNDAMENTALS OF THE ANALYTICAL MECHANICS OF SHELLS**
N. A. Kil'chevskiy Oct. 1965 373 p refs Transl. into ENGLISH of the book "Osnovy Analiticheskoy Mekhaniki Obolochek" Kiev., Izd. Akad. Nauk Ukr. SSR, 1963
(NASA-TT-F-292) CFSTI: HC $7.00/MF $2.00 CSCL 20K

Discussed are analytic methods of constructing elastostatic and elastodynamic systems of differential and integral equations of shell theory without requiring the use of additional assumptions on the deformation of the shells, and also methods of solving the systems of integral equations by reducing them to systems of ordinary differential and algebraic equations. No use is made of the well-known assumptions that constitute the foundation of classical shell theory, but the author starts out from the general principles of elasticity theory and derives more exact differential equations of the shell theory, of higher order than those of the classical theory. Author

**N65-36054** Watervliet Arsenal, N. Y.
**EFFECT OF COUPLE-STRESSES ON FORCE TRANSFER BETWEEN EMBEDDED MICROFIBERS**
M. A. Sadowsky, Y. C. Hsu, and M. A. Hussain *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 63–89 (See N65-36050 24-19)

The present report is a continuation of the Weitsman problem. The investigation is concerned with the nature of the stress field which develops in the presence of couple-stresses in composite material formed of microfibers embedded in a filler substance. The case is considered when one row consists of an infinitely long microfiber, while the second row is composed of two semi-infinite microfibers. An exact solution, based on a two-dimensional theory of elasticity with inclusion of couple-stresses is obtained for the stress field which is activated by giving the two semi-infinite microfibers a tangential displacement of separation. The couple-stress theory gives a better representation of the actual physical phenomenon than the classical theory of elasticity. This is especially true and essentially important for bodies having a dimension comparable to the crystal lattice parameter of the material. This is believed to be the case with an elastic microfilm in bond with microfibers. Author

**N65-36062** Army Materials Research Agency, Watertown, Mass.
**NATURAL FREQUENCIES AND MODE SHAPES FOR AXISYMMETRIC VIBRATION OF DEEP SPHERICAL CAPS**
Edward W. Ross, Jr. *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 195–229 refs (See N65-36050 24-19)

This paper contains the results of an approximate analysis of the axially-symmetric vibrations of deep spherical elastic shells. The approximation is based on the asymptotic formulas for Legendre Functions of large degree. The results are relatively simple approximate formulas for the natural frequencies and mode shapes under a variety of boundary conditions at the shell edge. The results agree very well with values obtained by Kalnins, using numerical methods. Author

**N65-36126#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**ON THE CONCEPT OF STABILITY IN STRUCTURAL MECHANICS**
V. V. Bolotin [1964] 21 p refs Transl. into ENGLISH

An analysis of the stability concept as used in structural mechanics is presented. Considered are general science, mathematical, and engineering concepts. Included are data on methods used to investigate stability; stability problems of elastic and elasto-plastic systems under conservative and nonconservative loadings; and methods of stability theory and kindred methods which do not contain the concept of stability in their formulation. The need for more profound analyses of the stability concept for the further development of divisions of structural mechanics associated with stability and kindred problems, is advocated. S.C.W.

**N65-36163#** Northwestern Univ., Evanston, Ill. Dept. of Materials Science.
**RATE OF GROWTH OF FATIGUE CRACKS AS CALCULATED FROM THE THEORY OF INFINITESIMAL DISLOCATIONS DISTRIBUTED ON A PLANE**
J. Weertman 2 Aug. 1965 21 p refs
(Contract Nonr-1228(32))
(TR-1; AD-620118)

The Bilby, Cottrell and Swinden crack theory is applied to the problem of the growth of fatigue cracks. It is found that if a total critical displacement is adopted as the fracture criterion, the theory leads to observed growth laws. Author

**N65-36164#** General Dynamics Corp., San Diego, Calif. General Atomic Div.
**REMARKS ON SIMILARITY SOLUTIONS FOR HYPERVELOCITY IMPACT**
T. Teichmann 26 Jul. 1965 12 p refs
(Contract DA-04-495-AMC-116(X); ARPA Order 71-62)
(GAMD-6501; AD-620193)

The following report discusses the use of similarity flows in certain hydrodynamic impact problems, as a basis for approximate analytical solutions. After a qualitative discussion of various ways in which such solutions may be obtained, a single derivation is obtained of a class of one-parameter similarity flows for problems in 1, 2, and 3 dimensions, which includes substantially all those used previously, and allows the superposition of constant uniform motions. The perturbation equations which relate the asymptotic form of the actual solution to such similarity flows (under some conditions) are explicitly formulated and the equations of the characteristic surfaces which determine their behavior are derived. Author

**N65-36171#** David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.,
**PARAMETRIC STUDY OF UNSTIFFENED AND STIFFENED PROLATE SPHEROIDAL SHELLS UNDER EXTERNAL HYDROSTATIC PRESSURE**
John J. Healey Aug. 1965 41 p refs
(DTMB-2018; AD-620669)

Hydrostatic tests were conducted on a series of 25 unstiffened, epoxy resin prolate spheroidal shells to study the elastic buckling behavior of this shape for geometries in the following range; length-to-diameter ratios from 1.25 to 4.00 and thickness-to-radius ratios from 0.02 to 0.10. These test results demonstrate conclusively that existing analyses for predicting

the elastic buckling strength of prolate spheroids are inadequate. Empirical elastic buckling equations, accurate within 5 percent for the range of geometries considered, were determined from the test data. Based in part on these results, an approximate method was developed for predicting the elastic buckling strength of ring-stiffened prolate spheroids. Test results on two stiffened epoxy resin models showed excellent agreement with the pressures calculated by this method. Equations are also proposed for the inelastic buckling of unstiffened and ring-stiffened prolate spheroids. Results are presented to illustrate the potential of these shells for deep-depth applications. Author

**N65-36195#** Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.
**STRESS WAVES IN BOUNDED MEDIA Quarterly Report, Dec. 1, 1964–Feb. 28, 1965**
Richard W. Watson, Karl R. Becker, and Frank C. Gibson 8 Apr. 1965 14 p refs Prepared for the Army
(AD-613935)

Phenomena associated with the interaction of intense stress waves at the free boundaries of simple media or at the interfaces between different media are being explored in detail from a fundamental aspect. Stresses generated by detonating explosives or from impact by high-velocity objects are of prime interest. The development of new methods and techniques for the solution of these problems are an integral part of the program. R.W.H.

**N65-36201#** Grumman Aircraft Engineering Corp., Bethpage, N. Y.
**FUSELAGE CUTOUT AND BULKHEAD WEIGHT PREDICTION, MULTI-STATION ESTIMATING METHOD**
J. Ng Sep. 1964 34 p refs
(ADR-09-13-64.1)

An investigation was made of a method for predicting target weights for circular ring bulkheads and weight penalties due to cutouts in the fuselage shell structure made from aluminum alloy. Particular regard was given to establishing the reliability of the prediction method and the correction necessary for nonoptimum design. In determining the predicted weight penalties for cutouts, an effort was made to allocate the total weight to the various reinforcement members such as skin, longeron, and frames. Correlation of the results show that the prediction method is not exact in predicting the weight distribution between individual reinforcement members. Although there is such a wide lattitude of methods in reinforcing a cutout, there is only a small weight variation in the optimum weight of total reinforcement. Since the predicted total weight penalty compares well with the actual total weight penalty, it is possible to predict the "cost" of a cutout. A machine program to calculate the predicted weight penalty of fuselage cutouts has been developed. Author

**N65-36229#** RAND Corp., Santa Monica, Calif.
**MULTIVESSEL STORAGE OF FLUIDS FOR PROTECTION AGAINST METEOROIDS**
Lloyd Kaechele Aug. 1965 54 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4293-PR; AD-620168)

A study is presented of the problem of protection against meteoroids in space storage and also of pressurized storage and thermal protection. For short space trips in sturdy vehicles, designed to withstand the rigors of boost and re-entry, the problem of meteoroid impact has been of relatively minor concern. The likelihood of damage, however, will increase for longer voyages in larger, more fragile vehicles. The possibility of providing safe, lightweight storage for fluids by using many small containers rather than a single large one is investigated. It is shown that multiple containers can be appreciably lighter in certain applications. A method for determining which storage system is best is developed, and the kinds of mission for which the multiple container may be better are indicated. Author

**N65-36236#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
**WEIGHT MINIMIZATION OF HONEYCOMB HEAT SHIELDS Technical Report, Mar.–Apr. 1965**
Robert T. Achard Jun. 1965 23 p refs
(AFFDL-TR-65-66; AD-620677)

A procedure for the design of minimum weight honeycomb structures for use as radiative heat shields is presented. Formulations are applicable to panels critical to intracell buckling and face compressive yield. Minimum weight is shown to occur at the condition where design variables produce a critical buckling stress equal to the compressive yield stress. Author

**N65-36246#** Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
**ON THE MECHANISM(S) OF STRESS-CORROSION CRACKING Technical Report No. 65-7**
E. N. Pugh Aug. 1965 66 p refs Submitted for Publication
(Contract DA-31-124-ARO(D)-258)
(AROD-5023-1; AD-620513)

A critical review has been made of some of the major theories of stress-corrosion cracking, with particular reference to the long-standing question of whether a single, generalized mechanism exists. It is concluded, largely on the basis of recent studies of α-brass and of aged aluminum alloys, that several different mechanisms are in fact operative in different systems, so that stress-corrosion cracking must be regarded as a generic term. Consideration is given to areas which require further study. Author

**N65-36255#** Catholic Univ. of America, Washington, D. C. School of Engineering and Architecture.
**PHOTOELASTIC ANALYSIS IN THE NEIGHBORHOOD OF CORNERS OF LONG STRIPS BONDED ON ONE SIDE AND SHRUNK Progress Report**
A. J. Durelli and V. J. Parks Aug. 1965 29 p refs
(Contract AF 04(611)-10378)
(PR-3; AD-620692)

The stresses present at the interface between the long edge of a strip and a rigid bar to which the strip is bonded, have been determined using photoelasticity. The loading is produced by the restrained shrinkage of the strip. The short ends of the strip have fillets of different configurations. Use is made of a newly developed technique to simulate the two-dimensional state of stress at the interface. The shape exhibiting the smallest stress concentration factor has been obtained. Author

**N65-36284#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**ON THE REDUCTION OF THREE-DIMENSIONAL PROBLEMS OF THE THEORY OF ELASTIC STABILITY TO ONE- AND TWO-DIMENSIONAL PROBLEMS**
V. V. Bolotin [1964] 14 p refs

The differential equations and boundary conditions describing the equilibrium of an elastic system, adjoining an unperturbed system, are derived and the appropriate variational principle is formulated. It is shown that this principle agrees with the known principle of stationarity of the second variation of the total energy of the system. Also, the variational principle is

used to reduce the three-dimensional problems of the theory of elastic stability to one- and two-dimensional problems. The differential equations and natural boundary conditions are derived for the problem of the stability of the plane equilibrium mode of a compressed elastic slab consisting of alternating hard and soft layers as an example of the application of the method. E.E.B.

**N65-36317#** North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
**DYNAMICS OF SHELL-LIKE LIFTING BODIES. PART II: THE EXPERIMENTAL INVESTIGATION**
A. C. Park et al. Wright-Patterson AFB, Ohio, Res. and Technol. Div., Jun. 1965 202 p
(Contract AF 33(657)-11115)
(SID-64-2074-2; AFFDL-TR-65-17, Pt. II, AD-620699)

The vibration modes and natural frequencies for nine typical shell configurations were experimentally determined. The models were of similar size and construction and consisted of three unstiffened models and six models stiffened with longitudinal stringers and transverse flexible frames. The models were mounted with fixed-free boundary conditions. At least the twelve lowest natural frequencies and vibration modes were recorded for each model. Author

**N65-36329#** Wisconsin Univ., Madison. Mathematics Research Center.
**THE CALCULATION OF EQUILIBRIUM STATES OF ELASTIC BODIES BY NEWTON'S METHOD**
H. F. Bueckner, M. W. Johnson, Jr., and R. H. Moore Jun. 1965 27 p refs
(Contract DA-11-022-ORD-2059)
(MRC-565; AD-620103)

The numerical calculation of equilibrium states of elastic bodies under large deformation, where the governing differential equations are nonlinear, is considered. Newton's iterative method is modified by a reparametrization scheme which makes it possible to obtain a global solution in problems where buckling occurs. The method is applied to the problem of the buckling of a shallow clamped spherical shell under uniform pressure. Author

**N65-36379#** British Hydromechanics Research Association, Harlow (England).
**REFERENCES ON OR RELATED TO STRESSES IN TURBOMACHINE ROTORS Bibliography**
Oct. 1964 13 p
(BIB-17) CFSTI: HC $1.00/MF $0.50

A bibliography is presented on radial flow, side-vane impeller configurations typical of centrifugal pumps and compressors and on rotors of other turbomachinery such as gas and steam turbines. Also, a number of references to work on rotating disks is included. Seventy-two articles are represented in the bibliography of which most of the references contain brief abstracts. E.E.B.

**N65-36492#** Lockheed Missiles and Space Co., Sunnyvale, Calif.
**ON THE EFFECT OF CONCENTRATED TANGENTIAL FORCES ON A SHALLOW CYLINDRICAL SHELL**
V. P. Shevchenko [1965] 4 p refs Transl. into ENGLISH from Dopovidi Akad. Nauk. Uk. SSR (Kiev), no. 7, 1965 p 864-867

From the equilibrium equations of a shallow cylindrical shell in Cartesian coordinates, the components of the internal stresses are derived and the functions of the displacements and stresses are evaluated. E.E.B.

**N65-36545#** Lockheed Missiles and Space Co., Palo Alto, Calif. Research Labs.
**PHOTOELASTIC INVESTIGATION OF LMSC RESEARCH SUBMARINE HULL**
A. R. Hunter Aug. 1965 85 p
(LMSC-6-65-65-20)

The proposed bi-spherical pressure hull design to be used in submarines was evaluated utilizing the three-dimensional "frozen" stress photoelastic technique. This evaluation was made using two plastic models, a bi-spherical hull model and a spherical shell model with hatch configurations. The models were subjected to external pressure loading and a programmed thermal cycle to freeze photoelastic stress patterns into the models. The models were then sliced, and stress distributions determined by photoelastic analysis of the slices. The photoelastic results indicated the higher bending stresses in the models than predicted by an analytical solution. The differences between analytical and photoelastic results were attributed to imperfect model geometry. Therefore, attention should be given to geometric parameters in the fabrication of the full scale submarine hull. Author

**N65-36586#** David Taylor Model Basin, Washington, D. C. Structural Mechanics Lab.
**TESTS OF MACHINED MULTILAYER SPHERICAL SHELLS WITH CLAMPED BOUNDARIES UNDER EXTERNAL HYDROSTATIC PRESSURE Final Report**
Kanehiro Nishida Aug. 1965 43 p refs
(DTMB-2012; AD-620744)

Six spherical shell models with clamped boundaries consisting of two and four layers were tested under external hydrostatic pressure to explore the feasibility of multilayer construction for application to hydrospace vehicles. In addition, four monolithic models were tested to provide a basis of comparison. Three of the multilayer shells were bonded with epoxy resin and the remaining three were not bonded. The bonded multilayer shell models collapsed at pressures approximately equal to that of the monolithic shells. The unbonded shells showed appreciable reduction in strength. Author

**N65-36603#** National Aerospace Lab., Tokyo (Japan).
**THEORETICAL STUDY OF TWO-DIMENSIONAL PANEL FLUTTER AND PANEL DIVERGENCE IN SUBSONIC FLOW. I: INCOMPRESSIBLE FLOW CASE**
Takao Ishii 1965 25 p refs In JAPANESE; ENGLISH summary
(NAL-TR-83; UDC-533.6.013) CFSTI: HC $1.00/MF $0.50

For two-dimensional pin-supported panels of finite length, the dynamic and static stabilities in incompressible flow were studied with the linearized unsteady aerodynamic force. The panels treated in this analysis are assumed to be initially flat and to be subjected to various axial loads. The difference of undisturbed static pressure across the panel is disregarded. The equation of motion is derived from the energy method. Generalized air-force is expressed in an analytical closed form which contains sine and cosine integrals. The first three modes analysis of "panel flutter" indicates that panel flutter is not possible in incompressible flow. The critical boundary of "static divergence" is obtained in the form of an equation and illustrative examples of the divergence boundaries of aluminum panels in the sea level atmosphere are shown. Author

**N65-36654#** Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
**SABOR III: A FORTRAN PROGRAM FOR THE LINEAR ELASTIC ANALYSIS OF THIN SHELLS OF REVOLUTION UNDER AXISYMMETRIC LOADING BY USING THE MATRIX DISPLACEMENT METHOD**

John H. Percy, Dhirendra R. Navaratna, and Stanley Klein May 1965 103 p refs
(Contract AF 04(694)-427)
(ASRL-TR-121-6; AD-617308)

A FORTRAN II program for the matrix-displacement, finite-element method of analysis of thin shells of revolution subjected to asymmetric or axisymmetric loading is presented. Included are descriptions of the structural idealization and the program. A complete FORTRAN listing of SABOR III is given together with the program flow diagram and input and output instructions. The complete results for two example problems are listed to enable the user to check the adaptation of the computer program to his facility. Author

**N65-36669#** Texas Univ., Austin.
**BEHAVIOR OF CONTINUOUS COMPOSITE MEMBERS UTILIZING PRECAST-PRESTRESSED CONCRETE RODS AS REINFORCEMENT**
Frank L. Hines (M.S. Thesis) May 1965 94 p refs
(Contract AF 33(608)-1121)
(AD-617411)

An experimental and analytical investigation was made of continuous prestressed concrete structures. The results show that the use of precast-prestressed concrete reinforcing rods to create continuity between multiple span girders leads to a sound structure to resist static loads, both at service loads and at ultimate load. The behavior of such structures is essentially elastic until the first cracking moment is reached. The initial steel stress in the strands allowed full use of the ultimate strength of the material without excessive crack widths until ultimate load was approached. Cracks were well distributed in the vicinity of maximum negative moment at the support. Cracks that formed under applied loads up to about 65% of ultimate, either closed completely or were small when the applied loads were released. The deflections of these specimens prior to reaching ultimate load provided ample warning of impending failure. Further, the specimens behaved in a ductile manner. The cracking stress in the slab deck increased with an increase in the percentage of precompressed concrete in the slab deck. E.E.B.

**N65-36674#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ANALYSES OF DESIGN ELEMENTS UNDER DYNAMIC LOADS (SECTION IV)**
V. V. Bolotin 20 May 1965 74 p refs Transl. into ENGLISH from Sb. Statey, Raschety Na Prochnost. Teor. I Eksperim. Issled. Prochnosti Mashinostroitel'nykh Konstrukt. (Moscow), no. 10, 1964 p 211-260
(FTD-MT-64-522; AD-618317)

Contents: Analyses of design elements under dynamic loads: Survey of investigations on the statistical dynamics of elastic systems; quasi-static methods, correlation methods, methods of kinetic equations, and comparison of methods, trends of future investigations. TAB

**N65-36690#** Aktiebolaget Atomenergi, Stockholm (Sweden).
**LOW CYCLE STRAIN FATIGUE, A SURVEY OF THE LITERATURE CONCERNING THE NATURE AND THEORY OF THE PHENOMENON, AND APPLICATION ON MATERIAL FOR SUPERHEATER CLADDING MATERIAL [TOJNINGSUTMATTNING, EN LITTERATURGRANSKNING AVSEENDE FENOMENETS NATUR OCH TEORI SAMT TILLAMPNING PA MATERIAL FOR OVERHETTARKAPSLING]**
Torsten Ericsson 29 Apr. 1964 119 p refs In SWEDISH; ENGLISH summary
(RMM-1165; ICAF-303) CFSTI: HC $4.00/MF $0.75

This report describes and discusses inter alia methods of low cycle strain fatigue testing, influence of various factors (temperature, frequency, stress concentrations etc.) on the number of cycles to failure and the possibility to calculate fatigue lives when certain data for the material are known. The calculations are based on the so called Coffin's equation

$$N_F^{1/2}\Delta e_p = e_F/2$$

where $N_F$ is the number of cycles to failure, $\Delta e_p$ the plastic strain range and $e_F$ the fracture ductility in a static tensile test. Coffin's equation is critically studied with reference to the appended diagrams and tables showing the relationship between strain and stress amplitudes and number of cycles to failure. Special importance has been attached to a presentation, as complete as possible, of data for materials of current interest in superheaters, Fe–Cr–Ni-alloys with contents of Ni more than 20 percent. Author

**N65-36720#** Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
**UPPER AND LOWER BOUNDS FOR THE FREQUENCIES OF RECTANGULAR CANTILEVER PLATES**
Norman W. Bazley (Battelle Mem. Inst., Geneva), David W. Fox, and James T. Stadter Jul. 1965 33 p refs
(Contract NOw-62-0604-c)
(TG-705; AD-467992)

The authors use a recently developed procedure for lower bounds and the Rayleigh–Ritz procedure for upper bounds to estimate frequencies of free vibration of thin rectangular cantilever plates. The applicability of the lower bound procedure is demonstrated, and calculations are given for a symmetry class of normal modes. The lower bounds seem to be the first rigorously obtained for this problem. The upper bounds are improvements over previously published rigorous results. Author

**N65-36730#** Measurement Analysis Corp., Los Angeles, Calif.
**RESPONSE OF ELASTIC STRUCTURES TO DETERMINISTIC AND RANDOM EXCITATION Technical Report, Mar.–Nov. 1964**
Richard L. Barnoski Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., May 1965 162 p refs
(Contract AF 33(615)-1418)
(MAC-403-04; AFFDL-TR-64-199; AD-619272)

A review is made of the basic dynamics theory for discrete and distributed systems when the excitation is deterministic. This review is considered necessary to easily understand the subject material. Integral expressions are then derived for the mean square value and correlation functions for the response of an arbitrary linear elastic structure subjected to stationary random loading. These derived results are then applied to illustrative structural problems. In this way, the association between the parameters in the theoretical expressions and the physical properties of structural systems is demonstrated. A principal objective is to explore the value and limitations of using classical theory as a tool for predicting structural vibrations in typical flight vehicles. The theoretical results for distributed structures subjected to stationary random excitation are noted to yield complicated analytical expressions even for uniform beams. The direct extension of the shown theoretical results to include typical flight structures, although technically accurate, is not considered practical. Author (TAB)

**N65-36733#** Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
**PROGRAMS FOR MACHINE COMPUTATION OF ROTOR BLADE DOWNWASH**

Nancy Ghareeb Aug. 1964 89 p ref
(Contract NOw-62-0100-d)
(TR-107-1; AD-619285)

Programs are given for the computation of downwash due to trailing wake and shed wake, original straight line approximation to wake, and rotor load analysis. TAB

**N65-36743#** Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
**THICKNESS–SHEAR AND FLEXURAL VIBRATIONS OF PARTIALLY PLATED, CRYSTAL PLATES Interim Technical Report No. 2**
R. D. Mindlin and P. C. Y. Lee Jun. 1965 30 p refs
(Contracts Nonr-4259(13); DA-36-039-AMC-00065(E))
(TR-3; AD-620890)

In this paper, mathematical solutions are exhibited which predict the influence of length and mass, of rectangular electrode platings, on the Q of the fundamental thickness–shear resonance and on the number and distribution of anharmonic overtones between the cut-off frequencies of the plated and unplated portions of AT-type quartz plates. Author (TAB)

**N65-36774*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
**DAMPING CHARACTERISTICS OF BUILT-UP CANTILEVER BEAMS IN A VACUUM ENVIRONMENT**
Robert R. Mc Withey and Robert J. Hayduk Washington, NASA, Nov. 1965 34 p refs
(NASA-TN-D-3065) CFSTI: HC $2.00/MF $0.50 CSCL 20K

Damping measurements have been made on solid and built-up cantilever beams in a vacuum environment to determine the effects on structural damping. The changes in damping characteristics are noted for various values of clamping pressure between beam laminates for the case of the built-up beam. Results indicate no significant changes in structural damping characteristics as a result of exposure to pressures as low as $1 \times 10^{-9}$ torr (0.13 $\mu N/m^2$). Author

**N65-36789#** Ford Motor Co., Dearborn, Mich. Philco Research Lab.
**PLASTIC STRAINS AND ENERGY DENSITY IN CRACKED PLATES. PART 1: EXPERIMENTAL TECHNIQUE AND RESULTS**
W. W. Gerberich Westport, Conn., Soc. for Exptl. Stress Anal. [1964] 32 p refs Presented at SESA Spring Meeting, Salt Lake City, 6–8 May 1964
(SESA Paper-873; AD-620393)

A technique is presented which allows separation of the principal plastic strains within an enclave at a crack tip in relatively thin plates. For plates with a number of crack lengths, several degrees of tensile loading are applied to five ductile materials with widely varying mechanical properties. Principal plastic strain distributions, plastic distortional strain energy density and total plastic energy are determined within the resulting plastic enclaves. It is shown that the degree of loading and strain-hardening greatly affect the principal plastic strain and energy density distributions and that this is reflected in the amount of strain energy that can be plastically absorbed at a crack tip. Author (TAB)

**N65-36839#** Little (Arthur D.), Inc., Cambridge, Mass.
**DESIGN CRITERIA, TECHNICAL CHARACTERISTICS, AND DESIGN CONCEPTS FOR AN AIR TRANSPORTABLE CONTAINER**
Charles W. Wood, John H. Watts, and Robert M. Lucas Ft. Eustis, Va., Army Aviation Mater. Labs., Jun. 1965 170 p refs
(Contract DA-44-177-AMC-210(T))
(C-66529; USAAML-TR-65-36; AD-619158)

This report presents the results of a study to determine the feasibility of containerization for Army resupply items. The study has been limited to air transportation of supply classes I through IV shipped from a point of origin in the United States to an overseas forward area. Container criteria for size, weight, cost, strength, effectiveness and general characteristics were developed. Then the design criteria were used as the basis for evaluating the suitability of various materials and conceptual container designs. An acceptable container design appears to be feasible. Author (TAB)

# 33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

**N65-35792*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
**EQUILIBRIUM THERMODYNAMIC PROPERTIES OF THREE ENGINEERING MODELS OF THE MARTIAN ATMOSPHERE**
Harry E. Bailey Washington, NASA, 1965 164 p refs
(NASA-SP-3021) CFSTI: HC $2.50/MF $1.00 CSCL 20M

Entropy, enthalpy, pressure, and sound speed of three carbon dioxide–nitrogen mixtures are presented graphically for wide ranges of temperature and density. The temperature range is $250° K \leq T \leq 25000° K$ ($\Delta T = 250° K$). The density range is $-7.0 \leq \log \rho/\rho_o \leq +3.0$ ($\Delta \log \rho/\rho_o = 0.2$). The chemical compositions of the three mixtures correspond to those selected as engineering models of the Mars atmosphere in NASA TN D-2525. Author

**N65-35855** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**PRESENTATION OF DISSOCIATED AIR AS A BINARY MIXTURE OF GASES DURING SOLUTION OF PROBLEMS OF BOUNDARY LAYER**
N. A. Anfimov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 65–73 refs (See N65-35850 24-23)

In studying heat exchange and friction on the surfaces of bodies moving through the earth's atmosphere at supersonic speeds, the dissociated air is usually considered as a two-component mixture of atoms and molecules. For a binary mixture of gases, the diffusion flow of every component is determined by derivative concentration of its own components. Therefore, the assumption made essentially simplifies the solution of boundary layer equations. This simplification should only be considered as a certain approximation. In this article, exact solutions are obtained and compared with approximate solutions. Author

**N65-35856** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**ONE OF THE METHODS OF DETERMINATION OF FRICTION AND THERMAL FLOW IN SELF-SIMULATING PROBLEMS OF BOUNDARY LAYER**

B. I. Reznikov and Yu. N. Smyslov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 74–82 refs (See N65-35850 24-23)

A method is expounded for the determination of friction and heat flow which is not related to the numerical integrations carried out for boundary layer equations. Comparisons are made, and show that for complicated systems sufficiently accurate calculations can be made. C.T.C.

**N65-35858** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**TEMPERATURE DEPENDENCY OF INTERNAL FRICTION DURING FORCED OSCILLATIONS OF MAXWELLIAN TWISTING PENDULUM**

S. I. Meshkov and T. D. Shermergor *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 98–108 refs (See N65-35850 24-23)

Internal friction in a twisting pendulum, the material of which is described by a rheological Maxwell model, is considered during forced oscillations. The Maxwell model gives internal friction, increasing with temperature, which is in agreement with experimental results. Different methods for measurement during large damping are discussed. It is shown that for a Maxwellian medium the reverse amplitude oscillations pass through a maximum with growth in temperature, whereas the internal friction monotonically increases. C.T.C.

**N65-35867** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**BOUNDARY LAYER IN RADIATING GAS**

L. M. Pavlov and Yu. D. Shmyglevskiy *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 170–178 refs (See N65-35850 24-23)

The boundary problems of planar and axially symmetric flows of radiating gases around plane surfaces are considered. Conditions are examined under which equations describing the flow of radiant energy may be simplified. Errors in the calculation of this energy are compared with results obtained by using Navier–Stokes equations. C.T.C.

**N65-35869** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**EFFECT OF RELAXATION ENTROPY LAYER**

A. A. Gladkov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 185–188 refs (See N65-35850 24-23)

Relaxation is examined in gases flowing around blunt bodies. It is assumed that the hypersonic flow is a nonviscous nonheat-conducting gas. It is also assumed that the conditions are such that the state of the gas remains frozen for a slanted wave, but for a shock wave, which is close to a straight line, relaxation times are high. The formulation of relaxation entropy layer parameters is emphasized. C.T.C.

**N65-35870** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**TO THEORY OF ENTROPY LAYER**

Yu. L. Zhilin *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 189–194 refs (See N65-35850 24-23)

In the flow of a hypersonic gas over slender sharp bodies, it is shown that the entropy layer appears at a large distance from the nose. The formation of this layer is connected with the distortion of the shock wave. Also, any stream line hits the entropy layer as the distance increases. An evaluation is made of the accuracy of known self-simulating solutions for flow over bodies. An analysis is included for using a strong explosion as an analogy to flow over a sharp flat plate or cylinder. C.T.C.

**N65-35871** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**ON THE STABILITY OF SIMPLEST THERMOHYDRODYNAMIC SYSTEMS**

N. A. Zheltukhin *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 195–200 refs (See N65-35850 24-23)

The systems are represented by channels of variable cross section in which a gas flows, and various processes such as heat, combustion, and mass transfer occur. Three configurations are considered: a system with three concentrated influences; a system with two concentrated influences acting at the inlet and outlet; and a dynamic system with three concentrated influences in which the effects of the entropy waves are neglected. C.T.C.

**N65-35872** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**HEAT EXCHANGE DURING THE FLOW OF LIQUID IN A FLAT PIPE IN THE PRESENCE OF A WEAK RADIATION FROM EXTERNAL SURFACES**

E. P. Zimin *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 201–204 (See N65-35850 24-23)

The perturbation method is used to find the solution of a quasi-one-dimensional system of equations. These equations describe the change of temperature in an incompressible liquid flowing between two flat infinite parallel plates in the presence of radiation from the external surfaces of the plates. The temperature distribution in the plates is also found. C.T.C.

**N65-35873** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CALCULATION OF THE CRITICAL DIAMETERS OF DETONATION OF LIQUID EXPLOSIVE SUBSTANCES**

A. N. Dremin and V. S. Trofimov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 205–216 refs (See N65-35850 24-23)

Under certain conditions in the detonation of liquid explosives in a tube, a decay of the wave front proceeds to a complete disappearance of the detonation when the diameter of the tube is less than some critical diameter. The calculation of this critical diameter is considered. The results of these calculations are listed, and experimental values are included for comparisons. C.T.C.

**N65-35874** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**THE DEPENDENCY OF THE BURNING RATE OF AMMONIUM PERCHLORATE ON DENSITY**

N. N. Bakhman, A. F. Belyaev, G. B. Lukashenya, and D. P. Polikarno *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 217–223 refs (See N65-35850 24-23)

A series of experiments are given in which the dependency of the mass burning rate on the relative density was determined for ammonium perchlorate. Experiments were conducted in a constant pressure bomb in nitrogen. The burning rate was measured with a photoregister and piezoelectric pressure transducer. C.T.C.

**N65-35875** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**AN ATTEMPT TO GENERALIZE DATA ON CRITICAL THERMAL FLOWS FOR BOILING LIQUIDS IN REGION OF HIGH FLOW VELOCITIES**

L. S. Shtokolov *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 224–229 refs (See N65-35850 24-23)

Experimental data are generalized for several liquids at high flow speeds and with the flow nucleus below the temperature of saturation. Results of experiments made with a 96% solution of ethyl alcohol are presented. Comparisons are made between these and previously obtained data, as well as with the conclusions of the hydrodynamic theory of heat exchange crisis during boiling. A relation is obtained for the boiling crisis of a liquid at high but finite flow velocities. This formula is compared with data obtained for water and ammonia, and is shown to satisfactorily describe their experimental data on critical thermal loads. C.T.C.

**N65-35935#** General Applied Science Labs., Inc., Westbury, N. Y.
**RESEARCH STUDIES FOR SUPERSONIC COMBUSTION**
Mar. 1965 56 p refs
(Contract AF 49(638)-991)
(GASL-TR-518; AFOSR-65-1311; AD-619091)

Fuels and conditions pertaining to supersonic combustion in ramjet engines are discussed. The areas covered include: (1) reaction kinetics of a hydrogen–air system; (2) diffusion and combustion of reacting gases; and (3) the testing of highly idealized combustion processes. Studies in the latter field indicate the speed range for supersonic combustion ramjets can be lowered to the 3 to 6 Mach number range. It is concluded that sufficient progress has been made on the understanding and analysis of supersonic combustion processes for application to the design of a practical ramjet engine. R.R.D.

**N65-35939#** Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
**A BIBLIOGRAPHY OF THE ELECTRICALLY EXPLODED CONDUCTOR PHENOMENON, SUPPLEMENT NO. 1**
William G. Chace and Eleanor M. Watson Jun. 1965 42 p refs *Its* Spec. Rept. No. 25
(AFCRL-65-384; AD-618131)

An annotated bibliography is presented on the electrically exploding conductor phenomenon. References are included on arcs, exploding wires, exploding bridge wire, light, mathematics, measurements, photography, shock waves, sparks, spectroscopy, switches, temperature, theory, X-rays, and exploding foils and films. R.N.A.

**N65-35971*#** General Electric Co., Cincinnati, Ohio. Space Power and Propulsion Section.
**ALKALI METALS BOILING AND CONDENSING INVESTIGATIONS Quarterly Progress Report No. 12, 1 Apr.–30 Jun. 1965**
G. L. Converse and F. E. Tippets, ed. 23 Jul. 1965 389 p refs
(Contract NAS3-2528)
(NASA-CR-54739) CFSTI: HC $7.00/MF $2.00 CSCL 20M

Experiments were conducted to obtain two-phase heat transfer and fluid flow data for potassium under conditions of boiling and condensing approximating those anticipated in large space turboelectric power systems. The status of the loop and test section, and of data reduction and evaluation are detailed for the 300 kw, 100 kw, and 50 kw projects. An analytical treatment of nucleate boiling heat transfer is given, including theoretical prediction of nucleate boiling heat transfer coefficients; analysis of the relationship between cavity size on the heat transfer surface and the wall superheat required to initiate bubble nucleation in potassium; and comparison of theoretical predictions with data from the 100 kw facility. Design procedures for calculating nucleate boiling heat transfer coefficients are recommended. Also included are derivations of helix equations, and an analysis of errors associated with the measurement of temperature differences in the 100 kw loop. M.G.J.

**N65-35983*#** National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
**RELATIVISTIC TRANSFORMATION OF THE TEMPERATURE AND OF CERTAIN OTHER THERMODYNAMIC QUANTITIES [TRANSFORMATION RELATIVISTE DE LA TEMPERATURE ET DE QUELQUES AUTRES GRANDEURS THERMODYNAMIQUES]**
H. Arzelies 2 Nov. 1965 16 p refs Transl. into ENGLISH from Nuovo Cimento (Bologna), v. 35, no. 3, 1 Feb. 1965 p 792–803
(NASA-TT-F-9911; ST-TR-THD-10408) CFSTI: HC $1.00/MF $0.50 CSCL 20M

The present memoir has for its object to show that the formulas thus far admitted are inacceptable, and that it is appropriate to construct the relativistic thermodynamics on new foundations. It is specified in particular, that the temperature is to be transformed according to the formula $T = T_0/\sqrt{1-\beta^2}$ and not $T = T_0\sqrt{1-\beta^2}$. Author

**N65-35990#** Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
**RADIATIVE HEAT TRANSFER AND CONDUCTION BETWEEN PARALLEL WALLS**
J. D. Buckmaster Apr. 1965 24 p
(Contract Nonr-2653(00))
(CAL-AF-1285-A-15; AD-619419)

In this paper a simple problem in each of the theories of radiation and kinetic transport is presented. In the first half the problem examined is that of the radiative heat transfer between parallel walls bounding a slab of hot gas. An exact solution to this problem is obtained in terms of the moments of Chandrasekhar's X and Y functions. In addition, exact results are obtained for the magnitude of the temperature discontinuity at each wall. These results confirm the accuracy of a simple slip analysis. The second half of the paper is concerned with the more difficult problem of kinetic heat transfer for the same basic geometry. A linearized relaxation model for the Boltzmann equation is adopted and simplified with the specific intention of obtaining equations formally identical to those of radiative transport. These equations are then solved for the heat transfer and temperature jumps using the results of the first section. Author

**N65-36059** Watervliet Arsenal, N. Y.
**TEMPERATURE FIELD IN A SLAB CONTAINING AN INSULATING FILAMENT**
M. J. Pascual, J. E. Zweig, and S. D. Beck *In* Army Res. Office, Durham, N. C. Trans. of the 10th Conf. of Army Mathematicians Jun. 1965 p 155–166 (See N65-36050 24-19)

An infinite slab of heat conducting material has plane parallel boundaries which are kept at constant but different temperatures, imbedded halfway between and parallel to these faces is a plane insulating filament infinite in length but of finite width. The steady state temperature field induced by this filament is determined by solving the equivalent two-dimensional problem. The method of conformal mappings is used since Laplace's equation in two dimensions must be satisfied by the required temperature function. The solution is obtained for a filament of arbitrary width k. Allowing k to approach infinity in such a way that one end remains fixed results in the solution for the case of a semi-infinite filament. An evaluation is made for various filament widths from which graphs of several flow curves and isotherms are constructed. Author

**N65-36119#** Los Alamos Scientific Lab., N. Mex.
**COMPUTER PROGRAM FOR SOLUTION OF THE ENERGY BALANCE AND HEAT TRANSFER OF A PULSED THERMONUCLEAR REACTOR**

J. E. Powers and F. L. Ribe [1965] 22 p
(Contract W-7405-ENG-36)
(LA-3347-MS) CFSTI: $1.00

A summary is given of the function and use of a Fortran program for use on the IBM-7094. The program is used to solve the energy balance and heat transfer of the pulsed reactor discussed in a feasibility study of a pulsed thermonuclear reactor. Author

**N65-36134#** Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
**TRANSIENT RADIATIVE COOLING OF A SEMI-INFINITE SOLID WITH PARALLEL-WALLED CAVITIES**
D. F. Winter Jun. 1965 30 p refs
(D1-82-0449)

A semi-infinite solid of blackbody material is separated into slabs by periodically spaced infinitely deep cavities bounded by plane parallel walls. The solid material is brought to uniform initial temperature and subsequently is allowed to cool by conduction in the interior and by radiation at the surfaces. The temperature history of the solid with cavities was calculated numerically. Similar calculations were performed to obtain the rate of cooling of the same material without cavities. Comparison is made between the apparent brightness temperatures measured at a great distance by a thermal radiation detector with a resolving power insufficient to discriminate between a smooth surface and one with cavities. It is shown that over a wide range of aspect angles the solid with cavities may have a higher apparent temperature even when the top surfaces of the slabs are cooler than the surface of a homogeneous solid. Phenomena such as the one described may be useful in the interpretation of measurements of infrared radiation from the lunar surface. Author

**N65-36138#** Atomics International, Canoga Park, Calif.
**HEAT TRANSFER AND VOID FORMATION DURING FORCED CIRCULATION BOILING OF ORGANIC COOLANTS**
F. Bergonzoli and F. J. Halfen 15 Jun. 1964 57 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8906) CFSTI: $1.50

The experimental results of an extensive parameter survey are reported for forced circulation boiling of organic coolants. The observed effect of dissolved gas on the onset of nucleate boiling and on the overall heat transfer behavior of boiling organic coolants is discussed. The boiling heat transfer and void fraction results for degassed coolants are correlated by existing models or modifications of existing models whenever possible. A new model is presented for the correlation of the void fraction data at or near saturation conditions. The possibility of application of this model to other systems and geometries is explored. The effect of system pressure and quality on the slip ratio of organic coolant vapor is illustrated. The tests were conducted in a closed circulation loop at low system pressures (1 to 2 atmospheres). A d.c. resistance heated test section consisting of a vertical, seamless nickel tube of 9/16 in. O. D. with a 0.042 in. wall thickness and having a heated length of 12 ft was used in these experiments. Author

**N65-36149#** Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
**PRESSURIZING VESSEL PERFORMANCE EQUATIONS**
K. D. Coughren Aug. 1965 33 p refs
(Contract AT(45-1)-1830)
(BNWL-116) CFSTI: $2.00

A mathematical description of a pressurizer is presented based on energy equations that relate internal energy to external inputs. These equations predict the performance of the pressurizer vessel. By convention, all inputs to the system were designated positive, and outputs were designated negative. The analysis was completed in two parts: insurge and outsurge. R.W.H.

**N65-36175#** RAND Corp., Santa Monica, Calif.
**OUT-OF-PILE THERMIONIC SPACE POWER SYSTEMS USING A GASEOUS HEAT-TRANSFER FLUID**
Anthony Leonard Sep. 1965 50 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4469-PR; AD-620650)

A study of the potential of space power systems composed of a high-temperature gas-cooled reactor and out-of-pile thermionic converters is reported. Emphasis is placed on the creep-rupture problem and the optimization of the radiator-converter configuration. Expressions for thermionic-converter efficiency and power density as a function of emitter temperature and collector temperature are developed. For a system using 750-psi helium at a maximum gas temperature of 3600° F, a specific mass of about 13 lb/kwe is estimated, excluding power conditioner and shield masses. A 1000-psi system using neon would have a specific mass of about 17 lb/kwe. Author

**N65-36181#** Stanford Research Inst., Menlo Park, Calif.
**THEORETICAL STUDIES OF DETONATION Quarterly Progress Report, Jun. 1–Aug. 31, 1965**
Michael Cowperthwaite 15 Sep. 1965 7 p refs
(Contract DA-04-200-AMC-916(X))
(QPR-3; AD-472691)

Equations of state are considered in a theoretical study of detonation. Various problems associated with determining such equations from shock wave data are examined, and complete and incomplete equations are discussed. The method used to define the relationship between the (e-p-v) and (p-v-T) equations is outlined. The polytropic equation of state is given as a specific example. C.T.C.

**N65-36271#** Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
**DIFFERENTIAL THERMAL ANALYSIS (DTA) OF OXIDE SYSTEMS IN AIR TO 1620° C AT ATMOSPHERIC PRESSURE Instrumentation Papers No. 72**
Cortland O. Dugger Jun. 1965 57 p refs
(AFCRL-65-466; AD-620231)

An apparatus used to perform differential thermal analysis of oxide systems in air at atmospheric pressure to temperatures of 1620° C is described. A tubular SiC heating element, capable of providing temperatures up to 1650° C in air, serves as both heat source and furnace chamber. An electrovolt programed controller coupled with a saturable core reactor and transformer maintains a preset rate of temperature rise and fall. A platinum sample holder with two wells is positioned in the uniform thermal zone of the furnace using an aluminum oxide rod as a pedestal. In these wells are inserted platinum vials containing the inert and sample materials with the differential thermocouple centrally embedded in the materials. The sample material also independently measures and records the environmental temperature as a function of the constant rate of temperature increase or decrease. A dynamaster X-Y recorder provides the means of plotting the temperature difference of the sample and inert material versus the sample temperature. The apparatus demonstrates excellent reproducibility to within ±3° C at 1580° C for compounds which were melted, resolidified, and melted again. R.N.A.

**N65-36292#** Picatinny Arsenal, Dover, N. J.
**THE ANTICIPATORY EFFECT, A STUDY OF THE BURNING MECHANISM OF DELAY-RELAY COLUMNS**
Martin Gilford, Burton Werbel, Garry Weingarten, and Lindbergh Key Mar. 1964 33 p refs
(PA-TR-3047; AD-432537)

A newly recognized phenomenon termed the anticipatory effect is reported and its probable mechanism discussed. This effect occurs upon the burning of delay columns pressed above typical relay and flash charges and is reflected, in some systems, by more than a 40% diminution of burning time when no thermally sensitive terminal charge is present. An important mechanism operative in propagative columnar burning of pressed delay composition is the passage of hot gases through pores of the column. These gases, reaction products of the burning delay composition in the upper portions of the column, evidently precede the flame front of the column and have been shown to ignite a terminally loaded relay charge at times shorter than would have been expected were the flame front along the initiating source for the terminal charge. This effect has practical significance as it relates to end item performance. In this investigation the anticipatory effect was characterized for columns in which various delay and terminal charge compositions were used. Author

**N65-36306#** Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
**ENTRY HEAT TRANSFER AT SUPER-ORBITAL SPEEDS Publication No. 64-7**
James A. Fay Aug. 1964 33 p refs
(Contract Nonr-1841(93); Grant AF-AFOSR-353-63)
(Publ.-64-7; AD-606869)

Estimates are given of the expected relative magnitudes of the modes of heat transfer at the stagnation point of a blunt body for flight velocities above 20 km/sec and for altitudes at which continuum flow exists to determine the principal mode of heat transfer. Convective heat transfer theories applicable in the velocity range of 10 to 20 km/sec are reviewed and the state of knowledge of transport properties is discussed. Measurements in shock tubes are compared with the theories. For higher velocities, an approximate theory is used to estimate the principal effects of ionization expected. Radiation heating due to continuum and line radiation is estimated from existing calculations to determine the flight conditions for which the shock layer becomes opaque and body size for which radiation exceeds the convective heating. For large size bodies at high altitudes, the radiant energy loss from the shock layer is an appreciable fraction of the energy flux in the free stream. For small bodies the convective heating is dominant. At altitudes below 30 km the diffuse transport of continuum radiation within a radiation boundary layer is important for bodies of vehicular size. R.N.A.

**N65-36373#** Suffield Experimental Station, Ralston (Alberta).
**ON THE MEASUREMENT OF TEMPERATURES IN SHOCK WAVES**
A. T. Froebel [1962] 8 p refs
(PMMP-200) CFSTI: HC $1.00/MF $0.50

This note describes introductory studies on the measurement of shock wave temperatures using a thin film heat transfer gauge. Temperatures measured with this technique showed fair agreement with those calculated from shock velocity. Author

**N65-36389*#** Connecticut Univ., Storrs. Dept. of Mechanical Engineering.
**HEAT TRANSFER STUDIES OF VAPOR CONDENSING AT HIGH VELOCITIES IN STRAIGHT TUBES Interim Progress Report, 1 Nov. 1964–30 Apr. 1965**
W. E. Hilding, F. L. Robson, W. P. Goss, W. A. Olsen, and E. A. Dennar Jun. 1965 31 p refs
(Grant NsG-204-62)
(NASA-CR-67479) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Experimental apparatus was developed for measuring flow characteristics in annular wave motion. Some experimental data are reported on the velocity, frequency, and height of annular waves. Calculated data from experimental impact pressure measurements with a Dussourd type impact probe are presented, graphically showing the concentration variation of liquid particles in the vapor core. A printout statement of the computer program for data reduction is included and the progress of the computer solution program for the mathematical model is discussed. A discussion and diagram of the condenser test unit under construction are presented. The unit is similar in dimensions to the model now in use but is instrumented with additional and improved thermocouple installations allowing a more precise determination of the local condensing heat transfer coefficient on the inside tube surface. A description of the annular mist flow model is given along with a discussion of the mathematical analysis development for this system. R.N.A.

**N65-36445#** Faraday Translations, New York.
**HEAT TRANSFER IN THE INITIAL SECTIONS OF FLAT AND RECTANGULAR CHANNELS**
I. N. Sadikov [1964] 8 p ref Transl. into ENGLISH from Inzh.-Fiz. Zh. Akad. Nauk Belorusskoi SSR (Minsk), v. 7, no. 9, 1964 p 44–51
(WAPD-TRANS-19)

Heat transfer in the initial sections of flat and rectangular channels supporting laminar flow is studied on the basis of the linearized energy equation. Results of calculations for the temperature field and Nu numbers in various sections of the channel along its length are presented. Author

**N65-36452#** Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
**FORCED CONVECTION HEAT TRANSFER IN FULLY DEVELOPED LAMINAR FLOW OF A HYDROMAGNETIC FLUID**
C. W. Tan and K. Suh Feb. 1965 34 p refs
(RE-201)

This report considers the effect of inertial, viscous, and magnetic forces on forced convection heat transfer in a fully developed flow of an incompressible, electric-conducting fluid subjected to a dc transverse magnetic field. Two types of surface conditions of parallel walls are presented: (1) constant wall temperature; and (2) uniform wall heat flux. The case of fluid flow with a low Prandtl number in which constant fluid velocity across the channel is approximated is also treated for both surface conditions. The temperature gradient in the flow direction and the contribution of $u \frac{\partial p}{\partial x}$ to the energy equation are retained in this analysis. In the constant wall temperature analysis, the problem is treated as an eigenvalue problem. In the uniform wall heat flux analysis it is found that for the closed-circuit case the contribution of $u \frac{\partial p}{\partial x}$ to the over-all heat transfer is significant. Author

**N65-36454#** Grumman Aircraft Engineering Corp., Bethpage, N.Y. Grumman Research Dept.

**MAGNETOHYDRODYNAMIC EFFECTS UPON HEAT TRANSFER IN CHANNEL ENTRANCE FLOWS OF FLUIDS WITH LOW PRANDTL NUMBERS**

C.W. Tan Mar. 1965 30 p refs

(RE-206J)

Heat transfer is studied in fluids with low Prandtl numbers under a transverse magnetic field at the thermal entrance region of a parallel-plate channel with constant wall temperature using the energy-integral method. Both laminar and turbulent flows are treated. A heat transfer parameter measuring the magnetic, electric, and thermal fields is introduced. Increasing the heat transfer parameter is found to increase the fluid temperature more in the core region than near the walls. Thermal boundary-layer development and the heat transfer rate are presented for the thermal entrance region of the channel. Comparison of the present analysis with results obtained by other investigators shows good agreement in the limiting case of fully developed liquid metal flows. Author

**N65-36526#** Faraday Translations, New York.

**CRITICAL HEAT FLUXES IN ANNULAR CHANNELS WITH HEAT SUPPLY FROM TWO SIDES**

G.V. Alekseyev, B.A. Zenkevich, and V.I. Subbotin [1964] 5 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh., Akad. Nauk Beloausskoi SSR (Minsk), v. 7, no. 9, 1964 p 30–33

(FT-6164; WAPD-TRANS-17)

Results are given covering the experimental investigation of critical heat fluxes in an annular channel with a two-way heat supply for a forced flow of water underheated to saturation temperature and a steam-water mixture. Author (NSA)

**N65-36533#** Atlantic Research Corp., Alexandria, Va.

**EFFECTS OF ELECTRICAL FIELDS ON BOILING HEAT TRANSFER Quarterly Progress Report, May 26–Sep. 30, 1964**

Charles R. Nichols, Jack M. Spurlock, and Michael Markels, Jr. [1964] 15 p refs

(Contract AT(30-1)-2404)

(NYO-2404-5)

Construction of a high pressure heat transfer loop, and a facility for the loop were completed. The loop was hydrostatically pressure tested and operated at atmospheric pressure to check its operation and control, and a series of runs was conducted on the high pressure test section configuration with the loop pressure maintained between 1 to 20 atmospheres. The test section and loop systems performed satisfactorily over this pressure range to produce boiling heat transfer data describing the effect of applied ac voltage on boiling heat transfer. Tabulated data are presented showing the effect of 60 cps ac voltage on heat transfer to water at 300 psi boiling on the uniformly heated inside wall of an annulus, and mass flow velocity curves are given. Comparison of the increases in steam energy flow produced by the ac field, with the increases due to an elevated mass flux (and no ac field), shows promise of a significant advantage afforded by the ac field technique. L.S.

**N65-36549#** McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.

**ON TRANSITION FROM DEFLAGRATION TO DETONATION**

Isaac Shanfield Aug. 1964 122 p refs

(Grant NRC G-1255)

(MERL-TN-64-2 (GD-22))

Combustion and transition phenomena in a cylindrical containing vessel were investigated, with a streak camera used to observe the processes. Experiments were conducted in an equimolar acetylene–oxygen mixture, at an initial pressure of 100 mm Hg and an initial temperature of 300° K; 1 and 2 inch cylindrical vessels were used, with exploding wires of .003 and .006 inch diameter. Observations showed: (1) The critical energy per unit width was the same for both vessels, and increased as the wire diameter increased. (2) Cylindrical flame accelerations and decelerations were due to interactions of the flame front with the multiple reflections of the original precursor shock. (3) True transition from cylindrical deflagration to detonation and not occur. (4) Pseudo-transition, due to shock-heating of the unburned mixture near the containing wall by the multiple reflections of pressure waves, occurred usually after most of the unburned mixture had been consumed. (5) Cylindrical transition resulted when turbulence was artificially generated by a spiral coil mounted on one sidewall. (6) Cylindrical retonation waves happened at the onset of detonation. M.G.J.

**N65-36564*#** Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

**CONVECTIVE HEAT TRANSFER IN A CONVERGENT-DIVERGENT NOZZLE**

L.H. Back, P.F. Massier, and H.L. Gier [1963] 49 p refs

(Contracts NAS7-100; DA-04-495-ORD-18)

(NASA-CR-67025) CFSTI: HC $2.00/MF $0.50 CSCL 20M

Experimental convective heat-transfer data are presented on turbulent flows subjected to large pressure gradients in a cooled convergent–divergent nozzle. The investigation covered a range of stagnation pressures from 30 to 250 psia, stagnation temperatures from 1030° to 2000° R, and nozzle-inlet boundary-layer thicknesses between 5% and 25% of the inlet radius. Results indicated that the heat-transfer coefficients increased with increasing stagnation pressure due to the larger mass fluxes. However, only at stagnation pressure above 75 psia were turbulent boundary layer values typical; at low stagnation pressures, the heat transfer coefficients were below typical values, although the boundary layers at the nozzle inlet were turbulent. A reduction of about 10% in the heat-transfer coefficient also resulted from an increase in the inlet boundary layer thickness between the minimum and maximum thicknesses investigated. M.G.J.

**N65-36570#** National Bureau of Standards, Boulder, Colo. Inst. for Materials Research.

**SOLUBILITY OF SOLIDS IN DENSE GASES**

J.M. Prausnitz Jul. 1965 49 p refs

(NBS-TN-316) GPO: $0.35

The thermodynamics of solid-dense gas equilibria is discussed, and two techniques are described for calculating the solubility of a solid component in a gas at high pressure. The first one is based on the recent empirical equation of state of Redlich which, in turn, is derived from Pitzer's generalized tables of fluid-phase volumetric properties. The second one is based on the Hildebrand–Scatchard theory of solutions. Both methods give good semiquantitative results but cannot accurately predict solubilities from pure-component data alone.

Author

**N65-36596#** Reactor Centrum Nederland, The Hague.

**EVALUATION OF THE HEAT TRANSFER AREA AND THE STEAM TEMPERATURE AS A FUNCTION OF POWER, FOR A VERTICLE STEAM GENERATOR, BY MEANS OF A DIGITAL COMPUTER**

G. Van Hulst and G.L. Pieterse Brussels, Euratom, 1965 35 p refs

(Contract Euratom-007-616-PNIN)

(EUR-2183.e) CFSTI: HC $2.00/MF $0.50

Calculations were made of the heat transfer area for the NERO and SENN steam generators based upon the local conditions. The relation between steam temperature and power is evaluated. An Algol digital computer code was used for the iterative calculation of the steam temperature, and the principle of the calculation method is presented in block diagram. NSA

**N65-36597** Gt. Brit. Ministry of Supply, London.
**THE COOLING OF HIGH HEAT LOADED SURFACES BY A COOLANT FORCED THROUGH THE PORES OF THE MATERIAL**
[1941] 15 p refs Transl. into ENGLISH from German
(LF-3; FB-1470) (Declassified)

Sintered materials are proposed for nozzles subjected to high temperatures in which a coolant is forced through pores in the nozzle. In this way every part of the nozzle is in contact with the coolant. In this report the quantities of coolant, necessary for such nozzles are calculated, the sintered material used is described and the first tests with such nozzles are referred to. A list of heat resistant materials is also given.
Author

**N65-36601#** National Aerospace Lab., Tokyo (Japan).
**THERMAL INSULATION CHARACTERISTICS OF FRP COATING**
Yukihiko Takenaka, Koich Egawa, and Koichi Ogawa 1965 14 p refs In JAPANESE; ENGLISH summary
(NAL-TR-81; UDC-536.21) CFSTI: HC $1.00/MF $0.50

FRP is used as thermal insulation material for rocket body and nozzle. The thermal insulation characteristics of FRP depend on its fabrication condition as well as its composing ratio of glass fiber and resin. A new method is proposed in this paper to determine these characteristics of FRP coating, as fabricated. It is illustrated that thermal insulation characteristics of FRP coating which is coated on the base metal plate having known physical constants, such as density, specific heat and heat conductivity, are determined from measurement of back side temperature variation of coating plate of which surface is heated under uniform and constant radiant heat. Author

**N65-36649#** Eidgenössische Technische Hochschule, Zürich (Switzerland).
**CONTRIBUTION TO THE THERMODYNAMICS OF DISTANT THERMOSTATIC EQUILIBRIUM ENTROPIES [BEITRAG ZUR THERMODYNAMIK DER VOM THERMOSTATISCHEN GLEICHGEWICHT ENTFERNTEN VORGANGE]**
Ludwig Silberring (Ph.D. Thesis) Juris-Verlag, 1964 66 p refs In GERMAN
(Prom.-3567)

The development of an entropy was analyzed as an invariant product of a linear and a nonlinear time function, and the transformation equations for the nonlinear components of the time function were obtained with the help of the nonlinear equilibrium theory. The critical Reynolds number was utilized in sample calculations on entropy developments in laminar and in turbulent thermodynamic flows. Transl. by G.G.

**N65-36716#** Boeing Co., Seattle, Wash.
**STUDY OF HEATING IN REGIONS OF INTERFERING FLOW FIELDS Monthly Technical Report**
S. L. Strack Dec. 1964 11 p refs
(Contract AF 33(615)-1202)
(MTR-12; AD-463721)

Organization and analysis of the data from the October interfering flow fields with tunnel tests was continued and several variables examined. Preliminary results are presented. The degrees of separation occurring at the Mach numbers and shock strengths tested are listed. Wall temperature, deflection angle, and Mach number effects are shown. Two dimensional plateau pressures compare well with those calculated by theoretical methods. Author (TAB)

**N65-36758*#** National Aeronautics and Space Administration, Washington, D. C.
**RAPID METHOD OF CALCULATING THE HIGH-TEMPERATURE HEAT CAPACITY OF SOLID INORGANIC COMPOUNDS [USKORENY METOD RASCHETA VYSOKOTEMPERATURNYKH TEPLOYEMKOSTEY TVERDYKH NEORGANICHESKIKH SOYEDINENIY]**
D. Sh. Tsagareyshvili and G. G. Gvelesiani Oct. 1965 10 p refs Transl. into ENGLISH from Soobshcheniya Akad. Nauk Gruzin. SSR (Tiflis), v. 37, no. 3, 1965 p 581–586
(NASA-TT-F-9711) CFSTI: HC $1.00/MF $0.50 CSCL 20M

Description of a rapid method of determining the coefficients a, b, and c in the Maier-Kelley empirical equation $C^{oT} = a + bT - cT^{-2}$, for the atomic heat capacity of a substance. Empirical equations for the three coefficients are set up, based on the temperature dependence of corundum. Theoretical and experimental high-temperature heat-capacity values for various inorganic and some organic solid compounds are tabulated. Author

**N65-36842#** Hoskins Mfg. Co., Detroit, Mich.
**STUDY OF HIGH TEMPERATURE THERMOCOUPLES Final Report, Jun. 1, 1963–Dec. 15, 1964**
B. Forrest Hall, Jr. and Norman F. Spooner 23 Mar. 1965 89 p refs
(Contract AF 19(628)-2957)
(AFCRL-65-251; AD-619038)

Materials suitable for use as components of thermocouples for temperature measurement in a graphite environment were investigated. The performance of the W/W26%Re thermocouple was evaluated up to 2500° C in the presence of graphite under different atmospheric conditions. Thermoelectric effects were associated with carbon-metal reactions as revealed by metallographic studies or test materials. The behavior of the thermocouple was found to be directly dependent on the carburizing potential of the atmosphere surrounding the wires. Temperature indications were found to be reliable within at least ±2% for up to 100 hours at 2400° C in argon at atmospheric pressure in a graphite furnace. However, reducing the pressure of replacing the argon with hydrogen or a hydrocarbon gas caused a decrease in the thermocouple output as a function of time and temperature. This was interpreted as the formation of intermediate junctions of Tungsten: Tungsten Carbide and Tungsten-26% Rhenium: Tungsten Carbide in the respective wires. Several thermocouple prototypes were constructed and were found to have features that could be useful in thermocouples for a graphite environment. Author (TAB)

**N65-36868#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**TEMPERATURE OF A PLATE IN A SUPERSONIC FLOW WITH RADIATION TAKEN INTO ACCOUNT**
I. N. Sokolova 5 Apr. 1965 24 p ref Transl. into ENGLISH from "Sbornik Teoreticheskikh Rabot po Aerodinamike" Moscow, Oborongiz, 1957 p 206–221
(FTD-MT-64-307; AD-615212)

This paper gives a method for calculating the influence of radiation in the computation of temperature of a plate streamlined by a flow of gas of high speed. These cases are considered: (1) absolutely heat-conducting plate, (2) absolutely non-heat-conducting plate, and (3) plate of finite thermal conduction. It is shown that at high Mach numbers, radiation strongly lowers the temperature of the plate. The article contains graphs and tables necessary for the calculations. Author

# 34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

**N65-35857** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
**EQUATION OF OPTIMUM SEASONAL CONDITIONS OF ENERGY SYSTEM AS PROBABILITY PROCESS WITH CONTINUOUS TIME**
N. A. Kartvelishvili *In its* J. of Appl. Mech. and Tech. Phys., No. 1, 1964 4 Mar. 1965 p 83–97 refs (See N65-35850 24-23)

A study of optimum seasonal conditions for hydroelectric energy systems is presented. A theoretical method is developed using a model of the Markov process with discrete time. An energy system is considered which consists of thermal condensation electric power stations and one hydroelectric station, whose reservoir, having seasonal, annual, or perennial adjustment, executes only energy functions and is the only one on a given river. C.T.C.

**N65-36115#** Joint Publications Research Service, Washington, D. C.
**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY, NO. 213**
2 Sep. 1965 52 p refs Transl. into ENGLISH of 4 articles from Chinese Publ.
(JPRS-31817; TT-65-32312) CFSTI: $2.00

CONTENTS:

1. SOME PROBLEMS OF SOLID STATE CONTINUOUS STIMULATED EMISSION S.-h. Liu p 1–23 refs (See N65-36116 24-16)
2. REGENERATION OF THE SKELETAL MUSCLES J. Chu p 24–37 refs (See N65-36117 24-04)
3. ACOUSTICS T.-y. Ma p 38–43 (See N65-36118 24-23)
4. GRADUATION DESIGNS OF ENGINEERING STUDENTS p 44–45

**N65-36293#** Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
**[GENERAL PHYSICS, PLASMA DYNAMICS, AND COMMUNICATION SCIENCES AND ENGINEERING] Quarterly Progress Report, Period Ending Nov. 30, 1964**
H. J. Zimmermann and G. G. Harvey 15 Jan. 1965 373 p refs (Grant NsG-496; Contracts DA-36-039-AMC-03200(E); AT(30-1)-1842; AF 33(615)-1083; Grant NSF GP-2495 et al)
(QPR-76; AD-612062)

Research activities in the following areas are reviewed: (1) general physics, including molecular beams, microwave spectroscopy, radio astronomy, optical and infrared spectroscopy, ultrasonic properties of solids, geophysics, noise in electron devices, magnetic resonance, X-ray diffraction studies, soft X-ray spectroscopy, mechanism of enzymatic reactions, physical acoustics, and electrodynamics of moving media; (2) plasma dynamics, including plasma physics, plasma electronics, and plasma magnetohydrodynamics and energy conversion; and (3) communication sciences and engineering, including statistical communication theory, process analysis and synthesis, processing and transmission of information, artificial intelligence, speech communication, mechanical translation, linguistics, cognitive information processing, communications biophysics, neurophysiology, neurology, and cardiovascular system studies. R.R.D.

**N65-36385#** EUROSPACE, Paris (France).
**PROCEEDINGS OF THE EUROSPACE U.S.-EUROPEAN CONFERENCE HELD IN THE U.S.A., APRIL–MAY 1965**
Jul. 1965 62 p Conf. held in Philadelphia and Goddard Space Flight Center, Greenbelt, Md.
(EUROSPACE-9961) CFSTI: HC $3.00/MF $0.75

Summaries of the presentations at the proceedings are given, along with excerpts from the discussion period which followed each speech. Topics covered include a review of European space policies; European industrial proposals; U.S.–European industrial cooperation; and indirect benefits from space activities. An address by James E. Webb, NASA administrator, on the expansion of international aerospace commerce is included. C.T.C.

**N65-36624** Baeumker (A.), Bad Godesberg (West Germany).
**LONG TERM PLANS FOR RESEARCH AND DEVELOPMENT, NO. XXII. AIR- AND SPACEFLIGHT TECHNIQUE AND NATIONAL POLITICS [LANGFRISTIGE PLANE DER FORSCHUNG UND ENTWICKLUNG, HEFT XXII. LUFT- UND RAUMFAHRT—TECHNIK UND STAATLICHE POLITIK]**
A. Baeumker 1964 33 p In GERMAN

This paper propagates the reasons and advantages of unified leadership for research and development in the aerospace industry. The formation of a new, independent research institute that combines industrial funding and basic research activities is recommended. Transl. by G.G.

**N65-36639#** Eidgenossische Technische Hochschule, Zürich (Switzerland).
**LOAD AND OPTIMAL MEASURING OF PLATES [TRAGLAST UND OPTIMALE BEMESSUNG VON PLATTEN]**
Rudolf Wolfensberger (Ph.D. Thesis) Buchdruckerei Stäfa AG, 1964 120 p refs In GERMAN
(Prom.-3451) CFSTI: HC $4.00/MF $0.75

Calculations on the minimum load value of concrete–steel plates, and on their optimum reinforcement under a given stress, were performed by computation of the following problem solutions: (1) definition of the elasticity parameters as functions of plastic forces and of cross sections; (2) approximation of the plastic factors by linear functions; (3) reduction of the plate to a finite, static variable system; and (4) solution for the elasticity vectors at single points. Matrices were developed by computer IBM 1620, for 12 different reinforcement possibilities and plate geometries under evenly distributed load conditions. Transl. by G.G.

**N65-36682#** Politecnico di Milano (Italy). Istituto di Aeronautica.
**THE AERONAUTICS INSTITUTE OF THE POLITECNICO DI MILANO [L'ISTITUTO DI AERONAUTICA DEL POLITECNICO DI MILANO]**
1964 12 p In ITALIAN *Its* Publ. No. 71 CFSTI: HC $1.00/MF $0.50

A description of the Aeronautical Institute of the Politecnico di Milano is presented. Building constructions, programs of study, and a brief historical sketch of the institute are included. Transl. by G.A.L.

**N65-36688#** Deutsche Vesuchsanstalt für Luft- und Raumfahrt, Porz (West Germany).
**ANNUAL REPORT 1964 [JAHRESBERICHT 1964]**
Peter Bruders, ed. Jun. 1965 204 p refs In GERMAN CFSTI: HC $6.00/MF $1.25

A breakdown of the organization, financing, and expenditures of the German research society for aerospace flight during 1964 is given. Detailed descriptions of the various activities in the following institutes are presented: Applied and

theoretical gas dynamics; turbulence investigations; applied mathematics and mechanics; turbine propulsion systems; density; materials research, etc. Transl. by G.G.

**N65-36699#** Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany).

**REPORT ON THE COMPUTATION CENTER OF THE GERMAN AIR- AND SPACEFLIGHT RESEARCH INSTITUTES FOR THE YEAR 1964 [BERICHT UBER DAS RECHENZENTRUM DER DEUTSCHEN FORSCHUNGSANSTALT FUR LUFT- UND RAUMFAHRT FUR DAS JAHR 1964]**

R. Ludwig Jun. 1965 37 p refs In GERMAN; ENGLISH and FRENCH summaries

(DLR-Mitt.-65-05) CFSTI: HC $2.00/MF $0.50

This annual report for 1964 contains a breakdown of the time the Siemens 2002 digital computer was used by the various aerospace research institutes. An appendix contains the list of completed and newly acquired programs. A brief review of the various algebraic research activities in the institutes for aerodynamics, airplane construction, airplane control, airplane mechanics, turbine propulsion, and interference is given.

Transl. by G.G.

**N65-36819#** National Aeronautics and Space Council, Washington, D. C.

**ROLE OF THE PRESIDENT'S SPACE COUNCIL**

Charles S. Sheldon, II 25 Oct. 1965 19 p Presented at the AIAA Luncheon, Washington, D. C., 4 Nov. 1965

Legislative history and membership of the President's Space Council are reviewed, and the work of the group is summarized. The council's relationship to the executive office is considered; and parallels are drawn between the council and Congressional committees, the Office of Science and Technology, and the Bureau of the Budget. Influence of the council is discussed in terms of making recommendations, maintaining impartiality in aerospace activities, and use of persuasion in implementing national policy. Comparison of U.S. and Soviet space programs is mentioned, and U.S. philosophy toward space competition is discussed. M.W.R.

**N65-36820#** Joint Publications Research Service, Washington, D. C.

**TRANSLATIONS ON COMMUNIST CHINA'S SCIENCE AND TECHNOLOGY NO. 222**

Jo-ku Tsao et al 5 Oct. 1965 31 p refs Transl. into ENGLISH of selected articles from K'O-Hsueh T'ung-Pao (Peking), no. 7, 20 Jul. 1965 p 648-658

(JPRS-32244; TT-65-32734) CFSTI: $2.00

Papers are presented dealing with the crystal structure of an orthochrombic system called solenite, epigenetic aluminite concretion, and the application of bioassay methods to entomology. Conference reports deal with semiconductors, thermal instruments and automation of thermal power plants, agricultural machine-building technology, draining and irrigation machines, glass, and enamelware. A mountain climbing expedition, soil physical chemistry, plant ecology, and reforestation of poplar trees are the subjects of four book reviews. M.W.R.

# Collections of NASA Documents

NASA is depositing its technical documents and bibliographic tools in twelve Federal Regional Technical Report Centers. Each Center, located in the organizations listed below, is prepared to furnish the general public such services as personal reference, inter-library loans, photocopy service, and assistance in obtaining retention copies of NASA documents.

**California**: University of California, Berkeley
University of California, Los Angeles
**Colorado**: University of Colorado Libraries, Boulder
**District of Columbia**: Library of Congress
**Georgia**: Georgia Institute of Technology, Atlanta
**Illinois**: The John Crerar Library, Chicago
**Massachusetts**: MIT, Cambridge
**Missouri**: Linda Hall Library, Kansas City
**New York**: Columbia University, New York
**Pennsylvania**: Carnegie Library of Pittsburgh
**Texas**: Southern Methodist University, Dallas
**Washington**: University of Washington Library, Seattle

In addition, NASA publications are currently being forwarded to the public libraries in the cities listed below:

**Alabama**: Birmingham
**Alaska**: Anchorage
**Arizona**: Phoenix
**Arkansas**: Little Rock
**California**: Los Angeles, Oakland, San Diego, San Francisco
**Colorado**: Denver
**Connecticut**: Hartford, Bridgeport
**Delaware**: Wilmington
**Florida**: Miami
**Louisiana**: New Orleans
**Maryland**: Enoch Pratt Free Library, Baltimore
**Massachusetts**: Boston
**Michigan**: Detroit
**Minnesota**: St. Paul
**Missouri**: Kansas City, St. Louis
**New Jersey**: Trenton
**New York**: New York State Library, Brooklyn, Buffalo, Rochester
**North Carolina**: Charlotte
**Ohio**: Cleveland, Cincinnati, Dayton, Toledo
**Oklahoma**: Oklahoma City
**Pennsylvania**: Pittsburgh
**Tennessee**: Memphis
**Texas**: Fort Worth, San Antonio
**Washington**: Seattle
**Wisconsin**: Milwaukee

An extensive collection of NASA and NASA-sponsored scientific and technical publications available to the public for reference purposes is maintained at the Technical Information Service, American Institute of Aeronautics and Astronautics, 750 Third Avenue, New York, New York, 10017.

*"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."*

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

# NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

**TECHNICAL REPORTS:** Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

**TECHNICAL NOTES:** Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

**TECHNICAL MEMORANDUMS:** Information receiving limited distribution because of preliminary data, security classification, or other reasons.

**CONTRACTOR REPORTS:** Technical information generated in connection with a NASA contract or grant and released under NASA auspices.

**TECHNICAL TRANSLATIONS:** Information published in a foreign language considered to merit NASA distribution in English.

**TECHNICAL REPRINTS:** Information derived from NASA activities and initially published in the form of journal articles.

**SPECIAL PUBLICATIONS:** Information derived from or of value to NASA activities but not necessarily reporting the results of individual NASA-programmed scientific efforts. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

***Details on the availability of these publications may be obtained from:***

SCIENTIFIC AND TECHNICAL INFORMATION DIVISION

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546